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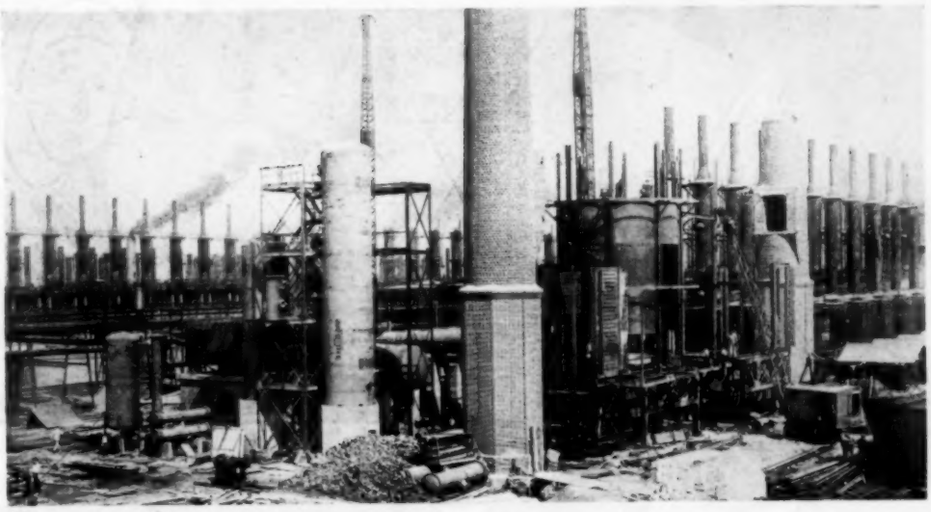

Two 3,000-Barrel Cracking Stills Under Construction in a Petroleum Refinery

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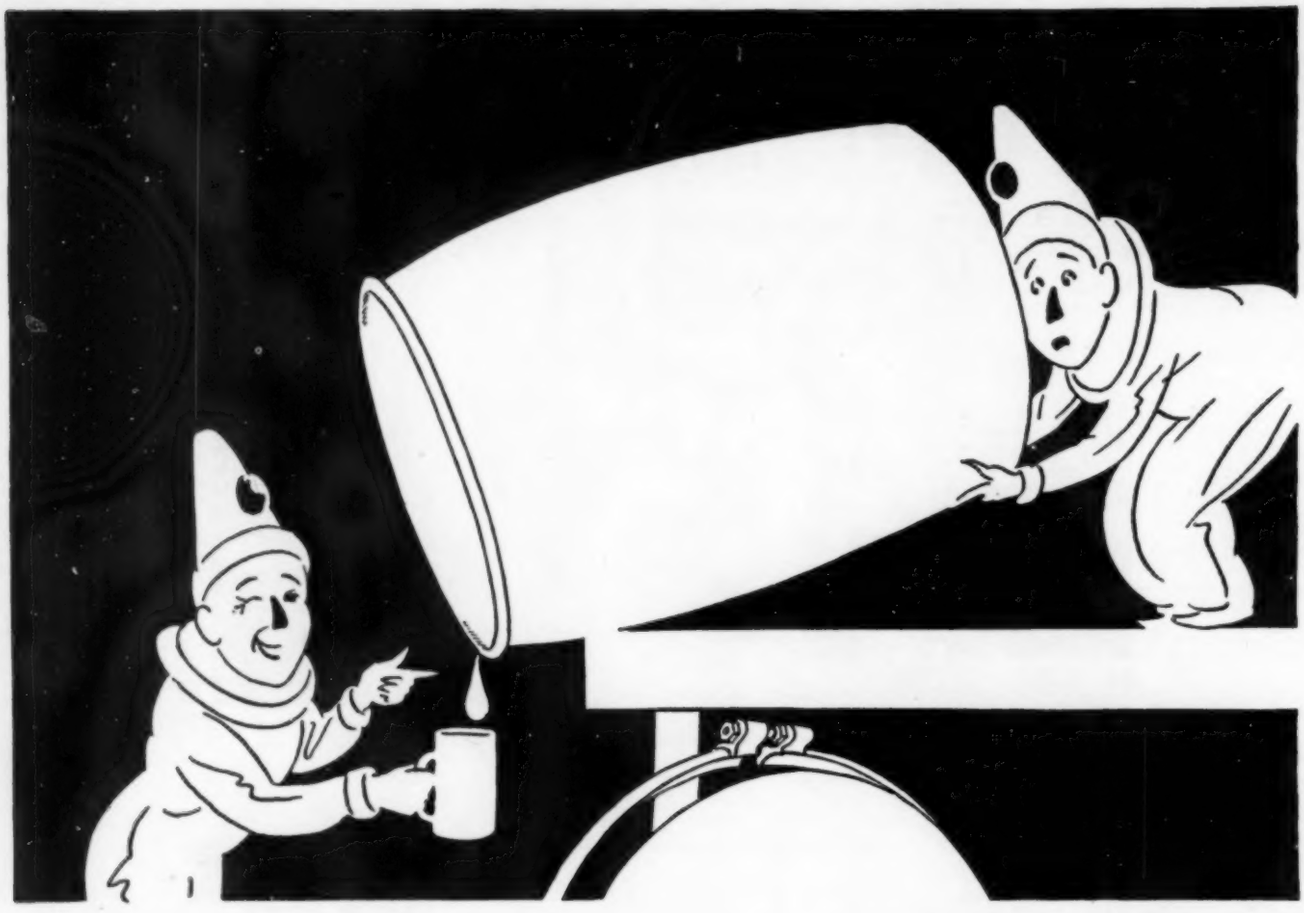

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VOLUME THIRTY-SEVEN

CHEMICAL & METALLURGICAL ENGINEERING

NUMBER THREE

A McGRAW-HILL PUBLICATION—ESTABLISHED 1902

MARCH, 1930

S. D. KIRKPATRICK, *Editor*

A House of Technologists

GLENN FRANK, president of the University of Wisconsin, is one of those who see an opportunity for the technologist to help in straightening out the apparently hopeless tangle in our national government. As our civilization increases in complexity, its problems become more technical and less political. The politician is proving himself pitifully incompetent in dealing with these complicated issues. Regionally instead of nationally minded, he approaches his task guided only by the selfish interests of his constituents. Lacking technical knowledge, he resents interference from qualified agencies, such as governmental commissions, or representatives of the industries and professions. All of which would seem to indicate that the present is an auspicious time to give thought to some fundamental revision of our system of representative government.

SUCH A PLAN has been proposed by President Frank. He would add a third house to Congress, to be made up of members selected because of their knowledge of the technical problems of government rather than their ability to capture votes or to dominate political conventions. This "House of Technologists," as he aptly calls it, would represent interests and professions rather than geographical districts or political groups. Without itself assuming executive, legislative, or judicial authority, it could competently advise other agencies and thus help to direct all governmental activities along scientific lines. Functional rather than regional in conception, it should encourage truly national statesmanship.

WHETHER we agree with President Frank or not, as engineers and business men we must recognize the imperative need for the very broadest application of the principles and methods of technology and business. Who is there to point the way? Dr. Arthur T. Hadley, president-emeritus of Yale, whose recent death meant the passing of another far-seeing friend of science, once said, "Let a man or a group of men arise who add to their technical knowledge a readiness to use that knowledge in the public service, then people will be ready to put them in charge of affairs and follow where they lead." Ex-president Hadley looked forward confidently to the eventual "recognition of the right of men of science to take the lead in enlightening the thought of the people in public affairs, even to the responsibility of filling the highest positions in the service of the commonwealth."

THAT THIS PROPHECY has been fulfilled in certain respects should not flatter the vanity of the engineer, but rather should give him a feeling of humility in approaching the tremendous task yet to be accomplished. Whether working individually or through the agency of the industries or the profession, the chemical engineer can contribute a great deal more to the public welfare. Discussion of such proposals as those of Dr. Frank and Dr. Hadley will stimulate our own thinking and perhaps lead the way to more constructive participation in national affairs.

EDITORIALS

MARCH, 1930

Patent Practice Bill Should Be Supported

FRAUDULENT practice before the Patent Office and the defrauding of applicants for patents will be sharply restricted if Congress passes the Cramton bill, which has been favorably reported to the House of Representatives as H. R. 699. *Chem. & Met.* has previously commented on this situation and pointed out the seriousness of the frauds which it is intended to restrict. This bill has been carefully revised to meet all reasonable objections on the part of the legal and engineering professions and of those representatives of industry who thought their interests were somewhat endangered by the original proposal. Therefore in unqualified measure we urge that this bill be supported. This can now be done in full confidence that the measure will not in any way result in the dire consequences which have been forecast for it by those who apparently are now indulging in the very questionable practices which the Cramton bill will effectively curb. Prompt action on the part of industry is essential, however, if we are to make sure that the bill becomes a law.

Dr. William H. Nichols, Leader of Chemical Industry

FOR sixty years Dr. William H. Nichols held unchallenged the position of acknowledged leader of American chemical industry. During that time he guided his own business from an extremely modest beginning to its present place at the very head of successful chemical corporations. That remarkable record was built largely on his own personal initiative, resourcefulness, and strict business integrity. Paralleling that was an equally remarkable record of wholesome interest and active participation in all the social, scientific, and professional activities of chemistry. Crowning both was a great human love for his family, his friends and his alma mater. There is no one to take his place in our affection and respect. Fortunately, the influence of his leadership remains to guide and inspire the future of American chemical industry.

Mergers and Profits in Stock-Market Prices

CHEMICAL enterprises have been widely affected by the fad for mergers in recent years. Fortunately, however, most mergers of a chemical sort seem to have been based upon sound economic principles and have had real merit, at least for their partial justification. Certainly our industries have not suffered as have many concerns in other lines of business, notably in the public utility field.

The main unfortunate effect of mergers of chemical companies seems to have been the creation of extravagant ideas as to the worth of concerns, based upon mere bigness rather than upon evidence of immediate or early profit. The fallacy of the theory that a merger always is profitable to stockholders has been more than demonstrated by the Wall Street collapse. We are returning to a sane basis of industrial appraisal and to a more rational relationship between stock-market value and earnings. The idea that any stock is worth 30 to 50 times its current earnings is fallacious, and fortunately is now so recognized.

Distribution of chemicals and of industrial products from chemical engineering enterprises is not yet upon as efficient a basis as can readily be created. Hence, we may look forward to still more consolidations and corporate readjustment. Technical men in the industries should welcome such changes when they can be justified by the measure of prospective saving in either production or distribution cost. They should, however, not be at all modest in raising their voices in protest when proposed changes savor merely of consolidations for stock-market effect and not for real technical advance. We have had far too many of the former sort in other industries and we should oppose them vigorously at every opportunity in our own fields. If there is not clear evidence of greater earnings, it is difficult to see how a consolidation can be justified. Industrial management will do well to bear this basic economic principle in mind.

Education for the Educated

"SOMETHING you got in your youth, like measles, and from which afterward you were immune," was the generally accepted prewar view of education, Prof. Frederick Keppel recently told the alumni of Columbia University. Fortunately, this opinion of education is now giving way to a realization of the necessity for continued study. The world is progressing rapidly, and new theories and practices are being brought forth in every branch of education. We find new methods of selling, of business administration, scientific discoveries. This is true of the sciences and their applications—particularly in chemical engineering, one of the very youngest. If a chemical engineer wishes to keep pace with this swiftly moving procession of development he should take advantage of the opportunities offered by the institutions and industries that are aware of the necessity for continued education.

That this condition is peculiarly necessary in chemical engineering, because of the recent advances in the theory of physical chemistry, thermodynamics, and allied subjects, has been recognized by Cooper Union. This institution has attracted during the present semester,

to a course in physical chemistry, 150 graduate engineers employed in chemical industries in the vicinity of New York City. These men hold degrees from colleges in the United States, England, Canada, Norway, Sweden, Germany, Austria, and South Africa. All but two have bachelor's degrees. Fifteen have master's degrees, and four the doctor's degree. That this course has been a success is proved by the plans for next year, which include courses in the unit operations of chemical engineering, embracing a study of the underlying theory of the flow of fluids, heat transmission, fractional distillation, drying, evaporation, extraction and absorption.

Among the other institutions of higher learning that are experimenting with this type of education is Lafayette College, which annually invites its alumni to attend a week of instruction in June. The University of Wisconsin instructs between 30,000 and 40,000 each year by correspondence. This same institution is trying the experiment of transferring the university to the field of industry; a professor from the department of metallurgy goes once a week to Milwaukee, where he instructs a class in the recent advances, in an effort to keep the former students of that department of the university up to date. Columbia University, Amherst College, and Brooklyn Polytechnic Institute were pioneers in the movement for adult education.

That industry is aware of the importance of employees continuing their educational activities is exemplified by the agreement effected between the Westinghouse Electric & Manufacturing Company and the University of Pittsburgh. Designated employees of this company apply part of their time to study at the university. Other companies no doubt provide comparable courses.

One of the most serious troubles with most college graduates is that just as soon as they stop inquiring and investigating, they retrogress. Scientific knowledge advances so rapidly that men determined to keep up with it must go back to school. The difficulty of keeping abreast of developments in the theory and practice of chemical engineering is almost insurmountable unless the graduate does accept such opportunities for continued study as those offered by these institutions.

But Is It Really Chemical Engineering?

"CONTRARY to practice in chemical-engineering laboratories, we have thrown out most experiments of this kind [small-scale manufacturing] and have recently decided to throw all of them out. We can see no object in having students do awkwardly with 100-pound batches experiments that can be done efficiently in a beaker. We have tried various experiments of this sort and have seen them performed in many other chemical engineering laboratories. It is usually not practical to set up a proper chemical engineering plant for carrying out the process. The result is that the students lug the materials around in buckets, use tubs for agitating kettles, and spend a good deal of time stirring the mess up with a stick, under the impression that they are learning chemical engineering. We occasionally do carry out chemical reactions on materials in quantity lots where we are in need of some particular material, but this is always in connection with some research project, and we attach no importance to the experiment itself. In other words, if we wish to reduce or sulphonate or nitrate a small quantity of material, we do as best we can, not for the sake of the experiment but for the sake of getting the material reduced or sulphonated or nitrated. We do not fool ourselves by thinking we are doing anything in a chemical engineering way."

This is the language in which Prof. Harry A. Curtis, of Yale, comments on one feature of chemical engineering education. It is a phase of the subject that has not received adequate attention from those responsible for planning the curricula of our educational institutions. It must be apparent to all that thorough training in the unit operations combined with laboratory study and demonstration of chemical engineering equipment will give the student much better knowledge of actual manufacturing processes. Furthermore, it will encourage precise methods and engineering technique that cannot possibly be attained with makeshift experiments of the "bucket-and-stick" type.

Lawless Use of Legitimate Materials

PROSECUTION of corn sugar, yeast, and other manufacturers who are alleged to be knowingly participants in the supply of raw material for illegal alcohol manufacture raises many fundamental and important questions. No one can conclusively say until the courts have spoken what is the legal status of a material purveyor even if he knows that his material is being used in an illicit business. Furthermore, there are many hurdles over which the federal prosecutors must jump before they will have reached their goal of convicting these alleged participants in illegal practice.

Producers and users of industrial alcohol have actively co-operated with the prohibition enforcement officials at Washington. They have had in return very fair co-operative treatment on the part of Commissioner Doran and his associates, which has been highly appreciated. Whatever may be the outcome of the pending cases, everyone will hope that this co-operation between industrial and government executives will be continued.

Chem. & Met. has long been an advocate of earnest and sincere co-operation with the federal prohibition authorities. It has consistently advocated and on this occasion again urges that the chemical engineering industries of the country shall make every possible effort to prevent diversion of alcohol to illegal beverage purposes. *Chem. & Met.* believes that whatever the legal status of a concern furnishing raw materials which may be used for bootlegging purpose, there is a moral responsibility involved. We cannot escape the conclusion that it is just as important for the purveyor of such materials to seek to hold them to legitimate channels of trade as it is for those who legally manufacture and sell alcohol to use every effort in preventing its diversion. No industry can afford to place itself in the position of connivance in illicit operations.

Manufacturing Naval S

By the STEAM *a*

One of the most interesting chemical engineering developments in recent years has been the utilization of waste wood from the cut-over pine forests of the South. The industry that has resulted from this application of technology has had to face a variety of economic and technical problems. In this article—the first of a series to deal with the steam-and-solvents industry — Mr. Palmer reviews the economic basis on which the whole development rests. Subsequent articles will describe the technology involved in naval-stores recovery, the utilization of the wood residues and, finally, the application of the products in chemical engineering industries.—The Editor.

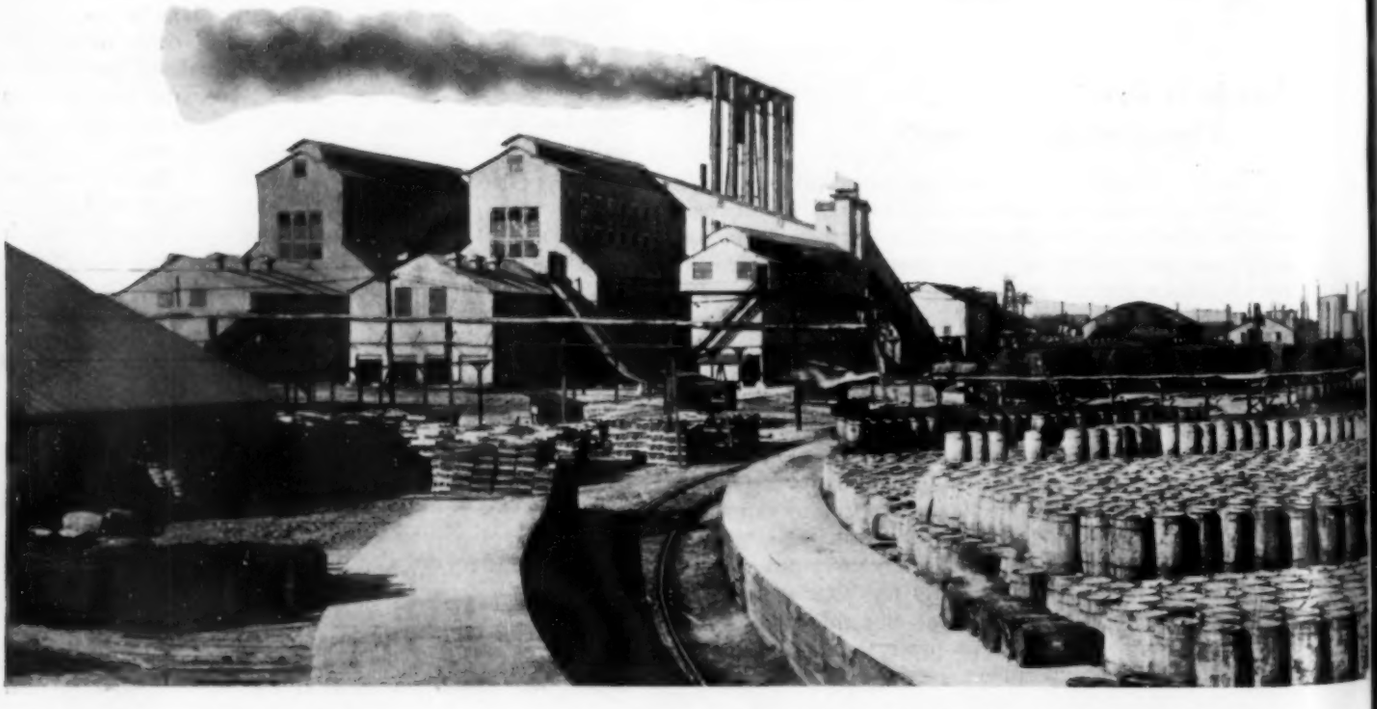
By R. C. PALMER

Chief Chemist, The Newport Company
Naval Stores Operations, Pensacola, Fla.
Bay Minette, Ala., De Quincy, La.

WHEN the steam and solvent division of the naval stores industry had its beginning, about twenty years ago, it was governed by very few of the basic principles essential to the operation of a modern, highly technical manufacturing business. Fundamental knowledge of the supply of raw material and its probable permanence, the technical soundness of the process, the relation of the products to competitive materials, and a definite program of expansion and development of both process and products—all were lacking. There were, however, certain definite considerations which prompted the industry to make its beginning. The long-leaf pine forests, which were the chief source of the world's supply of turpentine and rosin were being rapidly cut away by the lumbermen. The need of replacement by reforestation was fully recognized by foresighted interests, but was not being practiced. What was to be done about it?

These facts turned the attention of chemists and engineers to another potential supply of turpentine and rosin the exact quantity of which was not known, but which obviously was very great. The fat resinous wood left behind in the lumberman's destruction of the pine forests represented a tremendous but wasted asset. It was the day when conservation held the public thought. Owners of the cut-over pine forest lands were naturally interested and encouraged the new development. If successful methods of manufacturing these potential products from waste wood could be devised, it meant the possible clearing of large areas of land for agricultural purposes at low cost, or possibly even at a profit.

As is the case with most new chemical industries, the processes at the outset were far from perfect, either technically or economically. The methods were for the most part new and there was little experience with similar processes in other fields to serve as a guide.



Stores and SOLVENT PROCESS

Furthermore, the products made from the new source, while essentially the same turpentine and rosin well known to consuming industry, were nevertheless somewhat different.

At this stage of the development, too little attention was given to the quality of the products. Since not much was known of their chemistry, it is probable that this neglect of quality was to a large extent due simply to a lack of knowledge. However, the pioneers who succeeded in solving the engineering and chemical processing problems and then in overcoming the obstacles of marketing were finally rewarded in seeing their industry live and progress. This early period covered about eight years.

SINCE the new steam and solvent method of producing naval stores had sound economic reasons for its existence, since some of the plants apparently had solved the more important operating problems and since some demand had been created for the products, those engaged in the new industry were encouraged to provide additional financing and to plan substantial expansion. As a result, larger technical staffs were engaged, and this made possible the more rapid solution of the many unsolved problems relating to the products.

Steam distilled naval stores products were becoming well known, but because of either their fundamental characteristics or lack of proper refinement, they were being marketed only in limited fields.

One of the early discoveries in connection with this new source of supply of turpentine and rosin, which played an important part in the future success of the new industry, was the fact that from the resinous wood could be recovered a pine product not produced by the living pine tree. This was steam distilled pine oil. Being new, the possibilities of this product were investigated long before proper attention was given to the older well-known products, turpentine and rosin. It happened that the recovery and availability of steam distilled pine oil in large supply came at the time the mining industry was undergoing its revolutionary development incident to the flotation methods of recovering metals from low-grade ores. Steam distilled pine oil was found to be particularly valuable for this use and soon became a standard flotation reagent in the mining industry.

When consideration was finally given to the better known products, turpentine and rosin, it became clearly evident that the necessary improvements could come only after intensive chemical research and by the engineering development of better refining methods. Steam distilled

Pensacola Plant Where Waste Wood From the Cut-Over Pine Forests Is Distilled to Produce Naval Stores.

turpentine was the first to be studied. This research extended over a considerable period and the methods developed involving chemical treatment and the proper selective fractionation enabled the manufacturer to produce a pure product, which was received and used with entire satisfaction wherever pure turpentine was used.

Wood rosin was a product of special characteristics. Therefore, the main objectives of its development at this stage were primarily to recognize these characteristics and to make it a uniform, dependable product. This accomplished, many uses were found for wood rosin for which it was particularly suited. After the consuming industries became familiar with the product, some users began to inquire if the producers could not add this or that special property to wood rosin. In other words, rosin users began to realize that rosin produced under chemical control might be given properties or characteristics other than simply its color grade, which was then and still is the general standard of quality recognized as a price basis.

Another type of development affecting all phases of the industry was accomplished during this period. This was enactment of the U. S. Naval Stores Act of 1923, which was brought about by the constructive co-operation of all naval stores interests. This act officially recognized the standard products of both gum and steam distilled naval stores and was an important factor in establishing confidence between the consuming industry and the producers.

While at this time the new industry as a whole may be considered to have been definitely established, there were still many problems to be solved by the producers before the steam and solvent industry could expect any substantial expansion.

INSTEAD of a decreasing supply of gum naval stores, long predicted even to early extinction, reforestation began to make considerable progress. Improved methods of obtaining the crude gum were being developed, which resulted in larger yields and better all-around conservation of the natural source. To a considerable extent this was due to the continued and efficient efforts of the U. S. Forest Service and the U. S. Bureau of Chemistry. All of this resulted in a steady, if not increasing, supply of naval stores. Products from other industries became competitive substitutes, and the industry as a whole was not organized to change its methods of producing or marketing.

As one means of meeting this situation and in keeping with the general trend of sales methods in other industries, technical sales departments and technical sales service were established by the steam and solvent producers. These agencies had their own laboratories independent of the manufacturing operation, but co-operating with it, and were thus able to suggest desirable changes in the products. By intelligent co-operation with the consumer the laboratories made sure that he obtained the best result in his own processing with the new or modified materials. Naturally, the results obtained by these sales methods were accumulative.

Considerable progress has been made also in the chemical technology of rosin manufacture. The use of wood rosin, formerly confined to comparatively limited fields because of its natural characteristics of color and other properties, has been extended to many new fields by the development of processes for making wood rosin of all grades. With this accomplishment, the producers need only to continue their program of developing the particular properties which make rosin suitable for particular industries in order to secure the greatest possible benefit for both manufacturer and consumer.

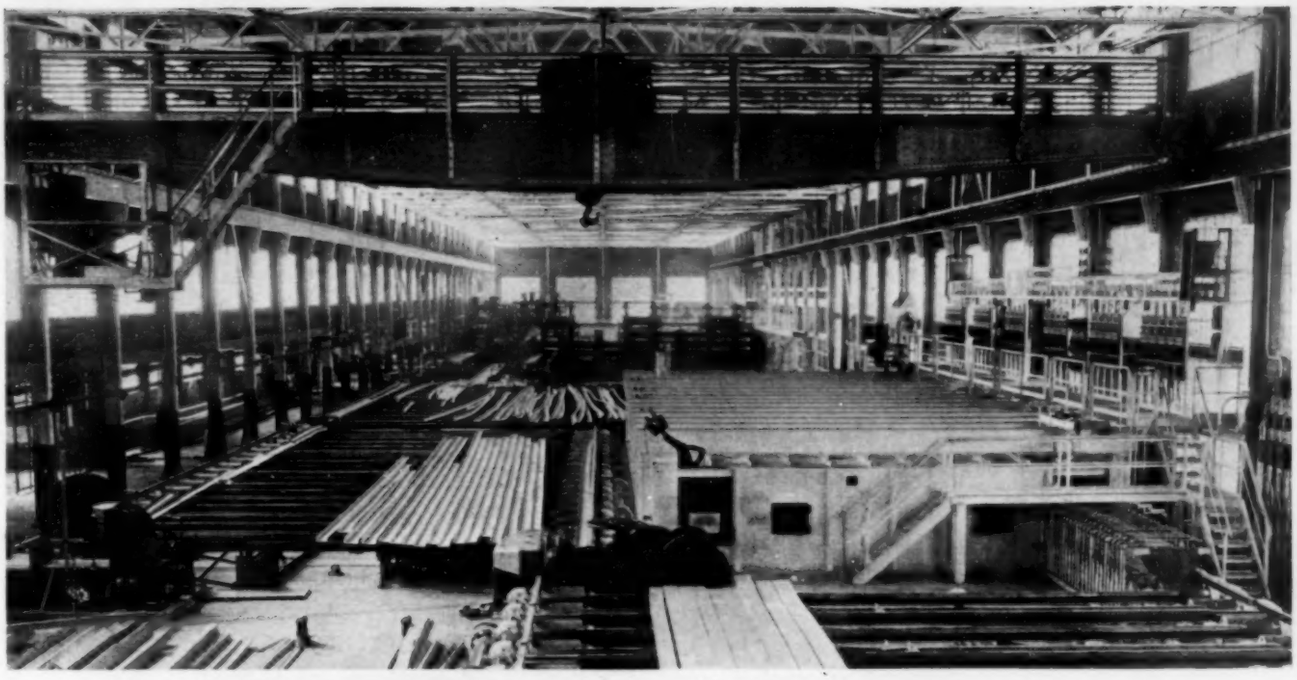
Progress has been made by the industry also in making naval stores byproducts from both rosin and pine oil. Such developments include the manufacture from rosin of crude and refined abietic acid. The more or less pure rosin acid has not heretofore been an available raw material in chemical industry and is, therefore, of special interest. From pine oil has been produced terpineol, borneol, and other natural constituents. Various terpene hydrocarbons also have been made from pine oil by chemical treatment. These synthetic products have various trade names and are made for special uses.

Even more recent progress made by the steam and solvent industry goes back to one of its original incentives, that of conservation of otherwise waste material. This most recent development may be said to round out the larger aspect of using the waste resinous wood left by the long-leaf pine lumbermen. The recovery of the naval stores from the wood by the steam and solvent process left the wood fiber itself in more or less its original state. This has served the industry since its inception as the necessary fuel to conduct the operation. It will now constitute the raw material for the manufacture of fibrous products, such as insulating or wall board. These will have valuable properties which the lumber from the original tree itself could not have.

NO QUESTION is more frequently asked than this: "How long can the supply of resinous wood be expected to last?" It is well known that the production of steam and solvent naval stores has increased very much in recent years. Six years ago the naval stores industry produced from this source about 10 per cent of the total, while the present production will more than double that quantity. To produce this quantity of turpentine and rosin requires the collection of wood from about 200,000 acres of cut-over land yearly. While the area of original long-leaf pine-forest land was many times that, the supply cannot last indefinitely even if there is no further increase in production from this source. The reforestation program is chiefly confined to rapid growing pines which are excellent gum producers, but the wood itself is relatively much lower in resin than the long-leaf pine.

From this viewpoint alone, the life of the naval-stores industry dependent upon the waste fat pine for its raw material might perhaps be limited, although it could flourish for several more decades on the same basis as at present. However, in estimating the probable life of the industry, an important consideration must not be overlooked. With normal progress in the development of new markets and new uses for the products together with the manufacture of more valuable new byproducts, both from the original naval stores and the wood fiber, a very great quantity of wood now discarded will in all probability become a profitable raw material for the industry. This consideration may also include the less resinous growing pine, so the future of the industry as regards its probable life seems well assured.

The future of the steam-and-solvent naval-stores industry is in many ways dependent on the progress of the entire industry. Well-defined plans of research, development, advertising, and all other phases of modern business procedure hold the key to a permanent naval-stores industry that will operate on a plane much more profitable to producers and to the greater satisfaction of the users of the products.



New Structural Rolling Mill for Aluminum and Its Alloys at Massena, New York

Various structural shapes are to be seen on the finishing tables. At the right is a 90-ft. electric heat treating furnace, the largest of its kind in the world. Twenty-six automatic temperature controls are to be observed on the balcony above the furnace.

An interesting feature is the 10-ton overhead traveling crane built of high strength aluminum alloys. Load tests have shown it to compete favorably with steel in strength and rigidity—yet with a saving in weight of 24,000 lb.

Aluminum Invades the Structural Field

ALUMINUM is in competition with steel despite the difference in cost and the tremendous spread between the aluminum "pot" furnace, with its daily output of a few hundred pounds and the modern blast furnace producing hundreds of tons of metal per day. In the forty-odd years since Charles M. Hall's experiments in electrochemistry laid the foundation for the present-day aluminum industry, the new metal has advanced step by step into the fields of nearly all of its older rivals. One of its latest advances takes it into the field of structural steel, where its light weight and great strength are likely to have revolutionary significance. Already structural shapes of strong aluminum alloy, 10-in. in cross-section and 90-ft. in length, are being used in the construction of modern equipment for the railways. Large slab-type aluminum ingots, 15x28x72 in., weighing 3,000 lb., are being rolled into the heavy plates used in the construction of aluminum tank cars for transporting acetic acid and other corrosive materials.

Massena, at almost the northern tip of New York state, is the scene of the most recent development. There the Aluminum Company of America, through its subsidiary the United States Aluminum Company, has just installed the largest blooming mill and structural rolling mill for aluminum in the world. Massena has long been one of the most important centers of the aluminum industry, accounting in 1929 for approximately 42 per cent of the metal made in the United States.

The new fabricating unit at Massena, which was visited by a group of editors on Feb. 27, 1930, consists of three production centers, viz.: a melting and ingot casting room, the blooming mill and the structural rolling mill. In the melting department the crude "pig" aluminum and the alloying ingredients are melted in coke and gas-fired open-hearth furnaces.

Prior to rolling, the ingots are preheated, or "soaked" in pit-type electric furnaces made by Wm. Swindell & Brothers, of Pittsburgh. An interesting feature of this installation is the use of aluminum busbars—a recent development in the application of the metal. The battery of 14 pits requiring 3,000 kw. is controlled within a definite temperature range by Wilson-Maeulen automatic regulators.

The breakdown or blooming mill at Massena is the largest ever used on aluminum; its rolls are 38 in. in diameter with 84-in. face. After rolling on the blooming mill, the billets are cut into the various lengths on an electrically operated billet shear and are then transferred on narrow-gage railroad cars to the structural mill or are loaded for shipment to other fabricating units of the Aluminum Company.

The structural mill at Massena with its auxiliary equipment is housed in a new building 900 ft. long x 95 ft. wide. As the billets are brought in from the blooming mill they are first heated in an oil-fired furnace in which the stock is carried through the furnace on an endless chain conveyor. An automatic unloader then lifts the billet from the furnace and starts it on its way through the huge three-high structural mill which quickly reduces it to the desired shapes. The piece is then carried on a power driven table to the heat-treating furnace—the largest of its kind in the world. As the piece is discharged from the furnace it is automatically quenched by means of high pressure water sprays. Some of the high strength alloys require additional tempering after heat treating, and for this purpose a steam-heated aging oven is provided. After straightening, cutting to proper length and weighing, the structural shapes are ready for shipment or for storing in the large space provided for the finished stock.

Where the Various Types of Gas Are Used

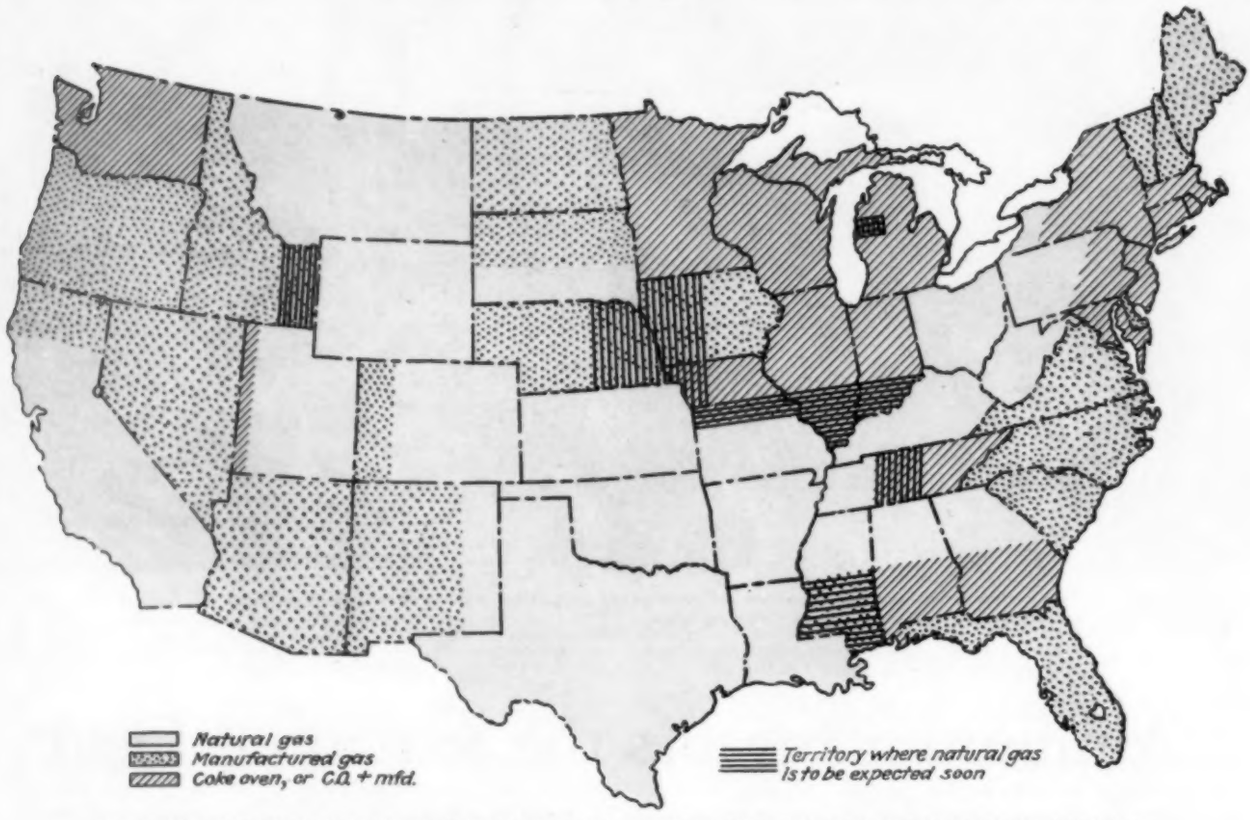


Fig. 1—Showing Kind of Gas Used in Each State and Territory Where Natural Gas Is to Be Expected Soon
Portions of states which are partially shaded do not represent the exact geographic portions so served, but the proportion of the state covered closely approximates the percentage by type of gas.

APPROXIMATIONS for the close of 1929 based on 1928 reports of American Gas Association for manufactured and coke-oven gases and on the Bureau of Mines report for 1928 on "domestic" natural-gas sales, corrected to present basis by estimates based on 1929 ten-month figures of the A.G.A., are given in the following tabulation. Where zero per cent is shown it often means only a negligible amount, usually 1 per cent or less, not necessarily absolutely none of the kind indicated.

Table I—Approximate Percentage and Kind of Gas Used in Each State

State	"Manufactured," Per Cent	Coke-Oven, Per Cent	Natural, Per Cent	State	"Manufactured," Per Cent	Coke-Oven, Per Cent	Natural, Per Cent
Alabama	5	45	50	Montana	5	0	95
Arizona	100	0	0	Nebraska	100	0	0
Arkansas	0	0	100	Nevada	100	0	0
California	20	0	80	New Hampshire	100	0	0
Colorado	20	0	80	New Jersey	60	40	0
Connecticut	40	60	0	New Mexico	70	0	30
Delaware	100	0	0	New York	60	30	10
District of Columbia	100	0	0	North Carolina	100	0	0
Florida	100	0	0	North Dakota	100	0	0
Georgia	50	0	50	Ohio	0	5	95
Idaho	100	0	0	Oklahoma	0	0	100
Illinois	30	70	0	Oregon	100	0	0
Indiana	40	55	5	Pennsylvania	25	15	60
Iowa	100	0	0	Rhode Island	45	55	0
Kansas	0	0	100	South Carolina	100	0	0
Kentucky	10	0	90	South Dakota	50	0	50
Louisiana	10	0	90	Tennessee	45	20	35
Maine	100	0	0	Texas	0	0	100
Maryland	40	55	5	Utah	0	5	95
Massachusetts	75	25	0	Vermont	100	0	0
Michigan	60	40	0	Virginia	100	0	0
Minnesota	60	40	0	Washington	80	20	0
Mississippi	70	0	30	West Virginia	0	0	100
Missouri	40	20	40	Wisconsin	70	30	0
				Wyoming	0	0	100

How Thermal Data Are Used In Drying Tower Design

By ALBERT B. NEWMAN
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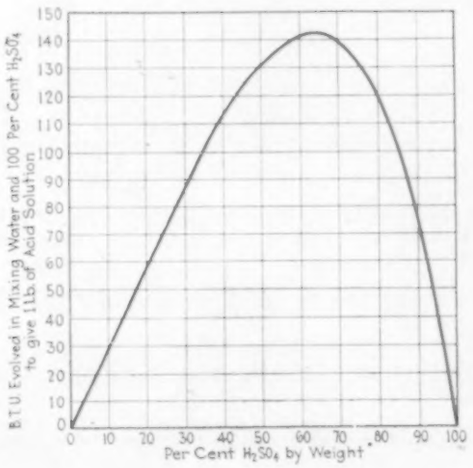
DRYING air or other gas by conducting it countercurrent to a stream of sulphuric acid in a tower is a common operation. Sometimes such installations are found to be giving poor results, and the engineer is called upon to study the variables under operating control in an effort to improve performance. Usually, these variables are the strength, quantity, and initial temperature of the acid used. The factor not subject to independent control is the pounds of water vapor to be removed from the gas in unit time.

Walker, Lewis and McAdams ("Principles of Chemical Engineering," second edition, pp. 675-690, McGraw-Hill Book Company, 1927) give a thorough discussion of the rational design of drying towers, based upon absorption rates. In both of their examples they specify that the towers shall be equipped with internal cooling coils to maintain substantially constant temperatures during absorption. Many existing towers are not so equipped, and the acid temperature increases from top to bottom, making the computation method of the above authors difficult to apply. In order to simplify the following discussion, it will be assumed that the dried air leaving the tower will have the same temperature as the incoming moist air, and that this will be also the temperature of the acid entering the top of the tower. In addition, it will be assumed that there are no cooling coils in the tower and that there is no escape of heat through the tower walls. It follows that all of the heat evolved by the condensing and dissolving of the water vapor will have to be carried off by the effluent acid, and that this will result in a temperature of the effluent acid higher than that of the entering acid. It also follows that the temperature of the effluent acid is limited by the water-vapor pressure exerted by acid of that strength and temperature, and that this vapor pressure cannot exceed the partial water-vapor pressure of the incoming moist air. Otherwise, the acid would give up a portion of its water content to the air.

Fig. 1—Heat Evolved When 1 lb. of Acid Solution Is Made by Mixing Water and 100 Per Cent H_2SO_4



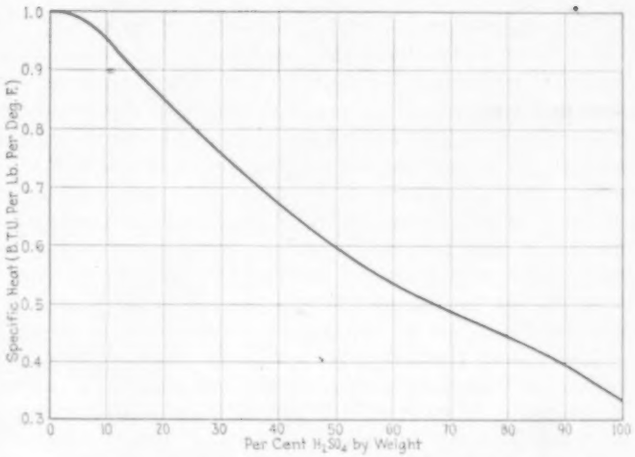


Fig. 2—Specific Heats of Various Strengths of H_2SO_4

Qualitatively, it is obvious that the way to carry off large quantities of heat in the effluent acid without excessive temperature rise is to have a large quantity of effluent acid. The larger the flow for the same quantity of water absorbed, the smaller will be the drop in acid strength from top to bottom of the tower. In order to predict the quantitative results obtainable by the adoption of various rates of flow, the heat evolved in mixing water with different strengths of acid should be known. These thermal relations are reported in the literature in terms of mol fractions, partial molal heat content, kilojoules, and so on, and require recalculation and interpretation for the busy engineer. It is the purpose of this paper to present these data in forms which can be applied directly to problems connected with the operation of drying towers and to other uses, and to show how the data may be applied.

Fig. 1 shows the heat evolved when 1 lb. of acid solution of any strength is made by mixing 100 per cent H_2SO_4 and liquid water. By simple calculations, this curve can be used also to predict the heat evolved when any known quantity of acid of one strength is mixed with a known quantity of another strength. As an illustration, one may find the heat evolved per pound of

93 per cent acid produced when 78 per cent acid and 98 per cent acid are mixed in ratio to produce this strength. First, it is necessary to calculate the weight of each of the strengths mixed to give 1 lb. of 93 per cent. Then the heat evolved in making 1 lb. of each of the three strengths from 100 per cent H_2SO_4 and liquid water can be read from Fig. 1. Multiplying these "per pound" values by the pounds of each strength involved gives the heat quantities shown in the last column of the following tabulation:

Lb. H_2SO_4		Lb. H_2O		Lb.		B.T.U. Evolved	
0.93	+	0.07	→	1.00 (93 per cent)	(1.00) (55)	=	55.00
0.735	+	0.015	→	0.75 (98 per cent)	(0.75) (17)	=	12.75
0.195	+	0.055	→	0.25 (78 per cent)	(0.25) (125)	=	31.25

0.75 lb. 98 per cent + 0.25 lb. 78 per cent → 1.00 lb. 93 per cent + 11.00 B.t.u.

The summation is found by subtracting the second and third lines from the first. Having found the B.t.u. evolved in making 1 lb. of 93 per cent by mixing the specified strengths, the temperature rise of the resulting pound of acid can be calculated if the specific heat is known. The specific heats of various strengths of sulphuric acid are shown in Fig. 2. The specific heat of 93 per cent acid is read as 0.362, and the temperature rise will be 11/0.362 = 30.5 deg. F. If the initial temperature of the unmixed acids had been 70 deg. F., the final temperature of the mix would be 100.5 deg. F. if no heat had been lost to the surroundings.

The above method gives good accuracy in cases in which one is dealing with acids of considerable difference in strength. However, it is not easy to attain accuracy in cases in which a small quantity of water is mixed with a large quantity of acid, causing only a slight change in acid strength. For these cases it is better to use a differential curve such as is shown in Fig. 3. The ordinates on this curve give a direct reading of the heat evolved when 1 lb. of water vapor is absorbed in such a large quantity of any strength of acid (within the limits shown) that the strength is not appreciably changed.

IF ONE wants to know the heat evolved when 1 lb. of water vapor is absorbed in acid of a given strength, resulting in acid of a strength not far different from the original strength, the ordinate corresponding to the mean strength will give the desired heat quantity. It is obvious that the ordinate values include the heat evolved by the condensation of 1 lb. of water vapor at a mean temperature. As an example of the use of this curve, one might want to know the heat evolved when 1 lb. of water vapor is absorbed in 98 per cent acid, resulting in 97 per cent acid. The ordinate at 97.5 per cent is read as 1,824 B.t.u. per pound of water vapor absorbed.

In order to calculate the temperature rise, the weight of resulting acid must be first computed and the specific heat read from Fig. 2. The weight is 98 lb. and the specific heat, 0.36. The rise will be 1,824/(98) (0.36) = 52 deg. F. Fig. 3 can be used also for approximating the heat evolved when a pound of water vapor is absorbed in a strong acid yielding a weak acid, by reading the value of the ordinate corresponding to the mean of the two strengths. Thus, one can estimate that the heat evolved in absorbing 1 lb. of water vapor in 90 per cent acid to give 70 per cent acid would be approximately the value of the ordinate at 80 per cent, or 1,363 B.t.u. The weight relations would be: 1 lb. water added to 3.5 lb. of 90 per cent gives 4.5 lb. of 70 per cent. Per pound of 70 per cent acid the heat would be 1,363/4.5 = 303 B.t.u. This indicates a greater temperature rise than is possible, and either cooling would have to take place during absorption or the absorption would have to be done in stages, with intercooling of the acid. Solving the same problem by the use of Fig. 1 gives:

Lb. H_2SO_4		Lb. H_2O		Lb.		B.T.U. Evolved	
3.15	+	1.35	→	4.5 (70 per cent)	(4.5) (138)	=	621.0
....	+	1.00	→	1.0 (00 per cent)	.....	.....	.....
3.15	+	0.35	→	3.5 (90 per cent)	(3.5) (75)	=	262.5

3.5 lb. 90 per cent + 1.0 lb. H_2O → 4.5 lb. 70 per cent + 358.5 B.t.u.

To this must be added the heat of vaporization of 1 lb. of water, read from the steam tables to be about 1,035 B.t.u., giving a total of 1,393 B.t.u., compared with

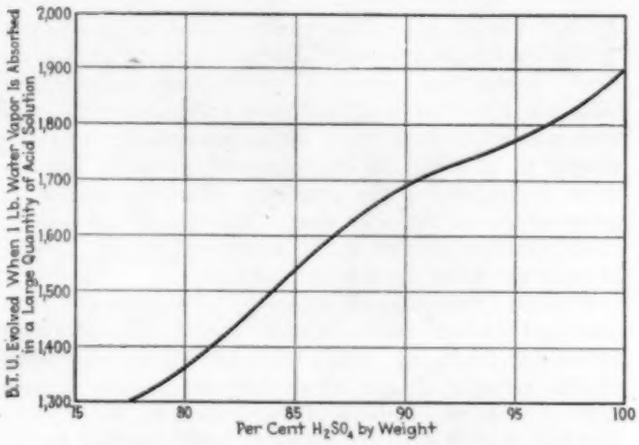


Fig. 3—Ordinates on the Curve Give a Direct Reading of the Heat Evolved When 1 lb. of Water Vapor Is Absorbed in Such a Large Quantity of any Strength of Acid That the Strength Is Not Appreciably Changed

1,363 B.t.u. read directly from the differential curve of Fig. 3. It can be stated that in dealing with wide strength ranges it is better to use Fig. 1, and that for narrow ranges, Fig. 3 gives better accuracy. To save time in rough estimating, Fig. 3 can be used over as wide ranges as are given, bearing in mind that Fig. 1 applies only to liquid water and Fig. 3 only to water vapor.

As illustrating the application of the data above to drying tower operation, consider the following problem: Air at 95 deg. F. having relative humidity of 50 per cent is to be dried and discharged from the top of a tower into which 98 per cent H_2SO_4 at 95 deg. F. is being charged. Assuming that the dried air is discharged at 95 deg. F., what is the minimum strength of effluent acid and what will be the corresponding rate of flow of 98 per cent acid as pounds per 1,000 cu.ft. of dry air at standard atmospheric pressure?

This will have to be solved by trial. Try 94 per cent as the strength of effluent acid. From Fig. 3, the ordinate corresponding to the mean strength (96 per cent) is 1,790 B.t.u. per pound of water vapor.

x lb. 98 per cent acid + 1 lb. water give (x + 1) lb. 94 per cent acid. 0.98x = 0.94 (x + 1), and x = 23.5 lb. 98 per cent acid per lb. water.

This will give 24.5 lb. of 94 per cent acid having specific heat of 0.36.

1790/(24.5) (0.36) = 203 deg. F. rise, or a final temperature of 298 deg. F.

Looking up the water-vapor pressure of sulphuric acid

solutions (International Critical Tables, vol. 3, p. 303, McGraw-Hill Book Company), it is seen that at 203 deg. F. (148 deg. C.) 95 per cent acid has a vapor pressure of 3.41 mm., and 90 per cent acid, 16.2 mm.

From these values it can be estimated that 94 per cent acid would have a vapor pressure of about 5 mm. The incoming air is at 95 deg. F. and, if saturated, would have a water-vapor pressure of 41.68 mm. Having relative humidity of 50 per cent, its water-vapor pressure is 20.93 mm. Therefore, it is seen that the vapor pressure of the acid does not reach that of the incoming air, and that a lower strength of effluent acid would be allowable.

On trying 92 per cent, the ordinate of the mean strength is found to be 1,720. The pounds of 92 per cent per pound of water absorbed is found to be $16\frac{1}{3}$. The rise in temperature is $1{,}720/(16\frac{1}{3})(0.37) = 285$ deg. F. or a final temperature of 380 deg. F. Again referring to the International Critical Tables, it is found that at this temperature 95 per cent acid has a vapor pressure of 28.3 mm., and 90 per cent acid, 95.2 mm. Obviously 92 per cent acid will have a vapor pressure lying between these two values, and this vapor pressure will be largely in excess of that of the incoming air. Therefore 92 per cent strength of effluent acid will be below the allowable minimum. By making further trials, it is found that the minimum allowable strength will be about 93.5 per cent and that for substantially complete drying about 26.1 lb. of 98 per cent acid will have to be fed to the tower for each 1,000 cu.ft. of dry air to be delivered at atmospheric pressure.

In the preceding problem, if the plant has no way of using the 93.5 per cent acid, it will be desirable to use the remaining drying capacity of this acid by cooling it and pumping it to the top of a second tower, the exit air of the second tower becoming the incoming air for the first tower. In this way, any number of towers can be placed in series, with intercooling of the acid, and the maximum allowable temperature for any chosen strength of final effluent acid can be found by reference to the vapor-pressure data and comparison with the vapor pressure of the original air to be dried. Having found this final temperature, the allowable temperature rise is found by subtracting the initial from the final temperature. Next, the theoretical rise involved in absorbing water vapor in the original strength giving the final strength can be computed as in previous examples. If this is much larger than the allowable rise, the number of towers in series can be approximated by dividing the theoretical rise by the allowable rise.

The underlying data for the construction of Figs. 1 and 3 were originally reported by Bronsted (*Z. physik. Chem.*, vol. 68, p. 700, 1909) and are given by Marshall (Taylor: "Treatise on Physical Chemistry," p. 213; D. Van Nostrand Company, 1924). Fig. 3 was derived from these data by graphical differentiation according to the method of Running ("Graphical Mathematics," p. 65; John Wiley & Sons, 1927). The specific heat curve was calculated from the data of Biron as reported by Lewis and Randall ("Thermodynamics," p. 86; McGraw-Hill Book Company, 1923).

Four Essentials to Success In Chromium Plating

FOR the successful deposition of chromium on a commercial scale, it is necessary to insure correctness and uniformity in the following four essentials: (1) Temperature of the solution in contact with the work. (2) Current density on the surface of the work. (3) Condition of the surface to be plated. (4) Composition of the solution. If these conditions are maintained, failure should be uncommon. The temperature of the solution proper must be kept within two or three degrees of the point desired. Oftener than is generally believed, the temperature of the bath is not the same as the temperature of the film of solution in actual contact with the work. This is especially liable to be the case when the work is cold and of large cross section.

Current density is the total current per unit area of the work and the rack. Controlling the current density within practical limits normally will mean the manipulation of the proper rheostats until the desired amount of current is passing. If the contacts are poor, however, the current passing through the work will not necessarily be the same as the current indicated on the ammeter. The current density in one part of the work is likely to be higher than calculated, while in another it may be lower.

The surface to be plated must be clean, free from grease and from oxide, and must not be passive. Passivity can be induced either by anodic cleaning or by prolonged buffing. This condition will hinder normal deposition. The quality of the undercoating can also be included as one of the conditions of surface which must be correct. If the underlying copper or nickel layers have been improperly applied, even though they may apparently be satisfactory after buffing, chromium plate will tend to strip them off. Steel and nickel require a little more careful regulation of current density than copper at temperatures in excess of about 90 deg. F., while at lower temperatures it becomes difficult to plate bright chromium upon these metals, at least on a commercial scale.

The fourth requirement, uniformity of composition of the solution, has received much more attention comparatively than it merits. If a good formula is adopted, precautions against contaminations are taken, and the solution is corrected periodically on the basis of the results of a chemical analysis or similar procedure, this matter should give the least amount of difficulty.

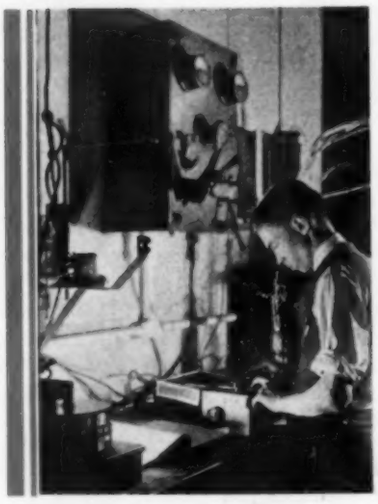
Means for insuring the first two of these four essentials of successful plating—uniform temperature and current density—are mechanical in nature and are to a large extent taken care of in the design and construction of the apparatus. The condition of the surface is a matter of procedure and manipulation. The fourth essential of a satisfactory solution is chemical in nature.

Extracts from "Commercial Chromium Plating," by Richard Schneidewind; Circular Series No. 3, Department of Engineering Research, University of Michigan.

CORRECTION—Robinson, Butler, Hemingway & Company, Inc., does not manufacture lacquer enamels, as might be inferred from the article, "Lacquer Enamel Production Simplified," in February *Chem. & Met.* This company makes the pigmented nitrocellulose paste for the lacquer enamel manufacturer, who, by its use, eliminates all grinding operations.

FORESTALLING

Industry's Fire, Explosion, and Poison HAZARDS



Hundreds of Pyrometers Are Calibrated Annually

By C. A. TIBBALS

Special Chemist, Underwriters' Laboratories, Chicago, Ill.

In this article the chemical engineering and chemical activities of a great non-profit laboratory are described

UNDERWRITERS' LABORATORIES, an Illinois corporation, which pays no dividends, was chartered in 1901 to establish and maintain laboratories for the examination and testing of materials, appliances, and devices, and to enter into contracts with owners and manufacturers of these materials, appliances, and devices in respect to the investigation of them and with report and opinion rendered to insurance organizations, and in respect to their inspection after examination, test, and report. The materials and devices thus investigated, reported upon, and subsequently inspected by means of one of several methods of follow-up service, belong in general to two great classes, namely:

(*a*) Devices and appliances which are intended to reduce the nation's fire loss as fire retardants, by fire prevention, and as means for fighting fires.

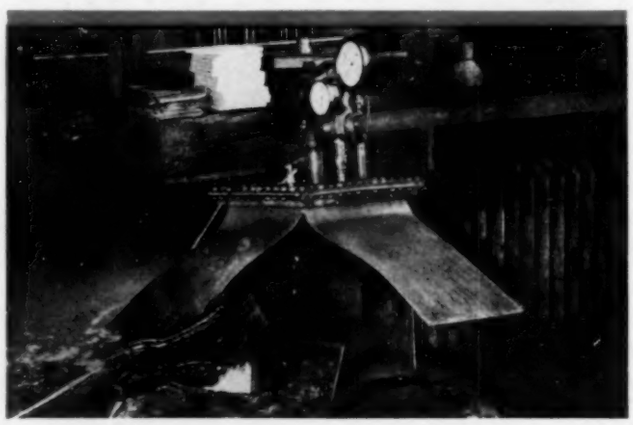
(*b*) Materials and devices which are of an inherently hazardous nature, or involve fire hazard in their application, in order that the hazard may be defined, controlled and minimized.

In addition to the above, devices and appliances for accident prevention, for theft and burglary protection, including automotive appliances, are investigated, with reports and follow-up service.

The findings and opinions of the Laboratories resulting from its investigations are intended primarily for the insurance organizations which established and maintain the Laboratories. These are the National Board of Fire Underwriters (founders), the National Board of Casualty and Surety Underwriters, and the Burglary Insurance Underwriters. The advices of the Laboratories are primarily intended to furnish information which may be of service to insurance organizations. In addition, these advices, which are available to all interested, are intended to be of broad public service in the direction of reducing loss of life and property values through fire, accident, and theft.

The Laboratories maintains its chief testing station at Chicago, electrical testing stations in New York and San Francisco, and has offices or engineers and inspectors in practically all large cities and industrial centers in the United States and Canada.

The engineering organization of the Laboratories comprises seven departments as follows: (1) The protection department, (2) hydraulic department, (3) electrical department, (4) department of gases and oils, (5) department of chemistry, (6) casualty and automotive department, and (7) burglary protection department. The order given is that of the establishment of the several sections.



Finish of Test on Cellulose Nitrate X-Ray Film

It is the writer's intention to describe the department of chemistry of Underwriters' Laboratories in so far as its work is of general interest to the chemical engineer and the chemist.

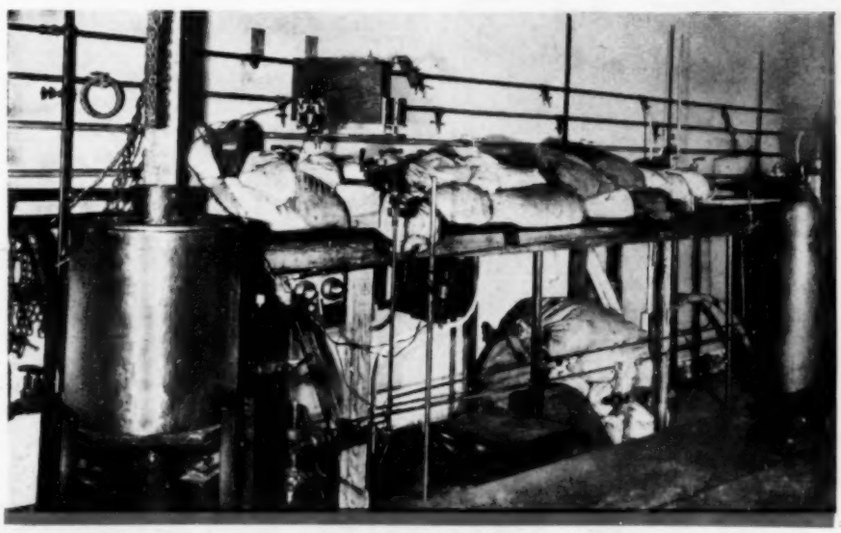
Personnel and Facilities—The chemical department

was founded in 1907 by A. H. Nuckolls, the present chemical engineer and department head. It was originally intended to function primarily as a consulting and service department, making tests at the request of other departments. At present the staff of the department includes 30 persons, of whom 15 are trained chemists or chemical engineers. The balance includes laboratory assistants, office force, and a mechanician. The floor space devoted exclusively to the laboratories and offices of the department is over 8,000 sq.ft. The laboratories of the department include:

1. A large general analytical laboratory, completely equipped for miscellaneous chemical analyses and such other chemical testing as is appropriate for a general laboratory.

2. A physico-chemical laboratory, which contains special equipment for physical chemistry, including a complete layout for the calibration of pyrometers, recording potentiometers, apparatus for the low-temperature fractionation and analysis of gaseous mixtures, a polariscope for the study of internal strains in glass, and numerous other special equipment.

3. An extraction laboratory, with facilities for the extraction of about 100 samples at once with various solvents.



Apparatus Used in Testing Flame Arrester For Use in Acetylene Gas Lines

4. A gas analysis laboratory.

5. A corrosion testing laboratory.

6. A metallographic laboratory and dark room.

7. A laboratory completely equipped for the physical testing of rubber and rubber products, especially insulated electrical wire and fire hose provided with rubber lining.

8. An explosion laboratory, which includes three large rooms equipped with special apparatus for use in studies of the phenomena of gaseous combustion and explosion, and in the testing of devices and equipments in which the hazards of explosion of combustible gases and vapors are involved. Since the problems studied and most of the apparatus used in this laboratory are unusual, they will be described in some detail below.

9. An explosion testing station, remote from the Laboratories and the city, for the testing of burglar-resisting safes by high explosives, other tests involving explosives, poisonous gases and, in general, all tests which demand for their safe conducting large open space and special protection for operators.

Other rooms contain a working library, a mechanician's shop, and facilities for the manufacture of standard copper sulphate solution for the use of inspectors throughout the country, as well as offices and desk space for the staff.

Rubber Division—The rubber division is the pioneer unit of the department, and the department's first work of major importance was done in the field of rubber in working out, with the co-operation of the insulated-wire and the fire-hose industries, standard specifications and test methods for the physical and chemical characteristics of rubber compounds for insulation and for rubber-lined fire hose. In connection with the investigation of rubber products and the test for compliance with requirements under Underwriters' Laboratories' standard specifications of previously recognized products, upwards of 5,000 specimens of rubber are subjected to physical and, in some cases, chemical tests, annually. Now, and for the past several years, investigations of accelerated-aging tests of rubber compounds are being carried on in co-operation with a large number of other rubber laboratories in the industry.

Explosion Testing Station—It has in recent years become important for the Laboratories to conduct tests covering:

1. The resistance of safes of certain types to explosive attack with nitroglycerine or other high explosives such as may be employed by burglars. (This work is done for the burglary protection department in connection with its testing of burglary-resisting safes.)

2. The explosive properties, if any, of certain materials when subject to fire conditions, percussion or high explosive shock. Such materials include certain types of synthetic fertilizer ingredients.

3. The performance under fire conditions of cabinets for the storage of cellulose nitrate photographic film, and other devices containing materials which may give off explosive or poisonous gases or smokes.

4. The hazardous characteristics of "poison gases" for commercial use as fumigants.

To the end that such tests might be carried forward effectively and safely, and without obligation to any outside organizations, the Laboratories acquired early in 1929 a tract of land near Lemont, Ill. This is about 30 miles from Chicago and has been developed into a complete testing ground which includes:

1. A chemical laboratory especially equipped for the preparation of nitroglycerine for use in high-explosive attack on safes. It is effectively guarded by rock barricades and a barbed wire fence.

2. An explosion room for making tests with high explosives upon safes, cylinders, etc. This room has a heavy concrete floor, heavy rock barricades as walls and a roof of steel rails.

3. An explosion pit protected by rock barricades and covered with a roof of steel rails, used for testing materials to determine whether or not they are liable to explosion or detonation under fire conditions or under high explosive shock.

4. A laboratory for use in testing poisonous gases and devices intended for the use or storage of poisonous

gases or which may evolve poisonous or explosive gases under fire conditions. This building is built of steel on a heavy concrete floor. It is practically gas-tight, and is provided with small mica windows for observation, facilities for the collection of gas samples for analysis, and for the operation of a sprinkler system.

A heavily barricaded retreat is provided for the safety of personnel during explosions.

Water is taken from a lake on the property by means of a small power house, and proper magazines are provided for safe storage of explosives and detonators.

The testing ground in its first year has already been used in tests upon representatives of all classes of materials and devices mentioned in connection with its description above.

Explosion Laboratory—The chemical department's most important work from the point of view of the advancement of chemistry and chemical engineering has been done in the studies of gas and vapor combustion and explosion. Devices studied and reported upon in the explosion laboratory include:

Flame arresters for preventing the propagation of flame in pipes, including the breather-pipes of gasoline and crude-oil storage and work tanks, acetylene pipe lines and others.

Electric motors designed for safe use in atmospheres which may be explosive by reason of the presence of flammable gases or vapors or of flammable dusts.

Switches and other electrical control devices intended for use in explosive atmospheres.

Lamps for use in hazardous atmospheres.

Devices for use in connection with the administering of flammable anaesthetics, including ether and ethylene and their mixtures with oxygen and nitrous oxide.

Cells for making oxygen and hydrogen by electrolysis.

Apparatus for the automatic and continuous analysis of oxygen or hydrogen gas for use in plants manufacturing these gases.

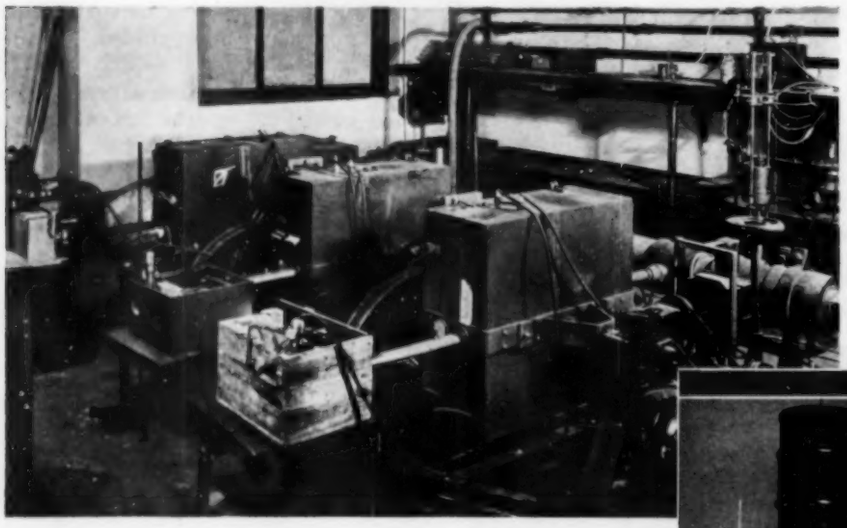
Apparatus for the detection, with indication of composition, of those common gases and vapors in air which may give explosive atmospheres.

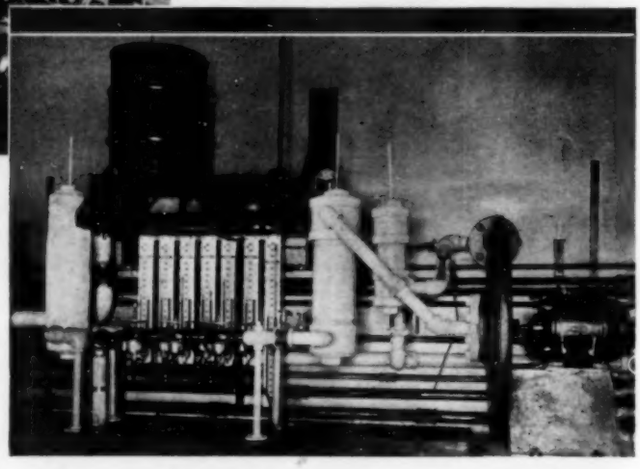
Equipment for dry cleaning of clothing and other textile fabrics under reduced pressures.

Materials investigated in the explosion laboratory for the evaluation of their hazards, include:

1. Propane, butane, ethane, ammonia, methyl chloride, and dichlor-methane as refrigerants.
2. Oxygen and hydrogen in respect to their explosive range when operating under pressures up to 2,000 lb. per square inch.
3. Pyroxylin lacquers and lacquer solvents.
4. Large numbers and varieties of volatile liquids intended for use as cleaning fluids, solvents, insecticides, and so on. In this connection the Laboratories has published in pamphlet form "Underwriters' Laboratories' Method for the Classification of the Hazards of Liquids," by A. H. Nuckolls, chemical engineer. (See also *Nation Fire Protection Assoc. Quarterly*, January, 1929.)

In order that the safety of a device, such as an electric motor, intended for use in explosive atmospheres may be determined, it is necessary that the explosive characteristics of the mixtures with air of all the flammable vapors and gases concerned be known. To this end, methods have been worked out and equipment designed and built for the determination of apparent ignition temperatures, flammable or explosive range in oxygen and in air, explosion pressures and rates of development of pressures throughout the range, in order that the most hazardous mixtures with air might be known and used in testing the device. In some cases, the velocity of flame propagation is also determined. These properties, or most of them, have been determined for a variety of materials including: gasoline, ethyl ether, propane, butane, illuminating gas, methyl chloride, ammonia, acetylene, and, to some extent, ethynol, acetone, and various lacquer solvents. While, in the working out of test methods and the construction of apparatus, full use has been made of available published records of previous and current work done elsewhere, many of the methods and equipments used are original.





Apparatus Above Is Used for Determining Rate of Flame Propagation in Flammable Gas-Air Mixtures. Such Mixtures of Known and Constant Quality Are Prepared From Gasoline Vapor and Air in Carburetor at Right

Among the special equipments for the study of gaseous explosion phenomena are:

A special carburetor developed at the Laboratories for the preparation of known and constant mixtures of gasoline vapor and air. This device has a capacity up to about 10 cu.ft. of mixture per minute. The proportions of vapor in air may be closely predetermined and when a given mixture is obtained, it may be kept constant for

long periods without further adjustment. The composition of the mixtures from the carburetor is constantly controlled for all tests by analysis by the well-known Burrell method, modified.

A second similar carburetor, of smaller capacity, is used for the preparation of mixtures with air of other vapors of volatile liquids which can be formed by the process of carburetion.

For the preparation of mixtures of "permanent gases" a system of high-pressure steel cylinders connected to a header with special high pressure valves and gages is used. The cylinders are installed in a pit outside the building in such a way that any explosion that might occur would not endanger life or property. Mixtures are prepared by the method of partial pressures, and are checked and controlled for all tests by analysis.

NO MATCHES LIGHTERS TORCHES LIGHTED CIGARS OR CIGARETTES ALLOWED ON PREMISES
UNDERWRITERS' LABORATORIES
PREMISES DANGER EXPLOSIVES

Views of Explosion Testing Station; Main Entrance at Left, Explosion Chamber Above

Special pipe assemblies are available for the testing of flame arresters in pipe lines up to 10 in. in diameter and in 10- to 15-ft. lengths.

A pipe 4 in. in diameter and 10 ft. in length has been equipped with special cameras with quartz lenses for photographing on moving film the passing of the flame front. This is used in determining the speed of flame propagation in flammable vapor-air or gas-air mixtures, timing by means of electrically actuated tuning-forks.

A steel bomb is provided in which explosion pressures and rates of pressure increase may be determined for mixtures throughout the explosive range of gases or vapors in air or oxygen. These investigations may be performed under initial pressures ranging from below to above atmospheric, as well as at or above normal atmospheric temperature.

Other work calls for the use of a larger explosion chamber which has been built in the form of a strong steel tank 8 ft. long and 5 ft. in diameter, installed in a concrete-lined pit. It is provided with connections for gas, air and vacuum lines, spark-plugs and pressure-measuring devices, and is gas-tight. It will enable studies of many gas and vapor-air explosions at initial pressures less than atmospheric on a larger scale than hitherto attempted.

In connection with the testing of electric motors for safe use in atmospheres which may be explosive on account of the presence of flammable dusts, extensive equipment has been developed for the production of dust clouds and explosive dusty atmospheres, and for testing motors in their presence.

For the measurement of explosion pressures, various types of gages are used, including the standard Crosby gage; modified Crosby gages designed and built in the Laboratories in which the lever system of the former is replaced by an optical system; and the piezo-electric pressure gage.

For use in fundamental researches in gaseous combustion and explosion, for which funds have been appropriated by the directors, a Westinghouse multiple-unit oscillograph and a quartz spectograph have recently been added to the equipment of the laboratory.

Much of the work of the explosion laboratory remains unpublished, although several reports of investigations have been printed by the Laboratories and are available to anyone interested at approximately the cost of printing.[1] Some work is unpublished because of the desire of the submittor of the device involved that details of the work be kept as confidential. In other instances, the vital facts regarding a device are developed without such complete studies as would be desirable in a published research, it being manifestly unfair to expect a submittor to supply funds for carrying an investigation further than absolutely necessary. The Board of Directors has appropriated funds for the rounding-out of some of these investigations and for financing the preparation of papers for publication.

Other Investigations—Investigational work is carried on in the Chemical Department in one of two ways, that is, as "Special Investigations" financed by the Laboratories and as investigations of materials and devices submitted by manufacturers who pay the direct cost of the work based upon materials used and engineers' time spent. Among the former a number of examples may be mentioned:

A study of the corrosive and toxic properties of carbon tetrachloride and liquids employed in fire extin-

[1] Underwriters' Laboratories' Report, Special Investigation No. 528, on the "Propagation of Flame in Pipes and Effectiveness of Arresters," by A. H. Nuckolls, October, 1919.
[1] Report on the "Fire Hazard of Ethane, Propane, Butane and Ammonia as Refrigerants," by A. H. Nuckolls, December, 1923.
[1] Report on the "Fire Hazard of Methyl Chloride as a Refrigerant," August, 1926.

guishers of the carbon tetrachloride type, when applied to fires of various kinds.[2]

An investigation of the possibilities of the formation of sulphuric acid in rubber-lined fire hose. This was carried out in co-operation with the manufacturers of Underwriters' Laboratories' Standard fire hose, and the report has not been released for publication.

A study of the terne plate used in the manufacture of standard "tin-clad" fire doors. The purpose of this was to ascertain the quality of plate furnished by the industry and to work out a basis for, and develop, standard specifications and standard test methods, for this product.

A thorough investigation of the hazards of cellulose acetate X-ray film, with special reference to the smoke and fume hazard to health and life when this material is involved in a fire. The complete report of this investigation has not been published but a résumé of it was printed in "Laboratories' Data" for September-October, 1929.

A comprehensive study of high temperature measurement by means of pyrometers of all types in connection with temperature measurement problems involved in the use of the Laboratories' furnaces for the fire-exposure testing of windows, doors, partitions, floors, columns, safes, and so on. Hundreds of base-metal thermocouples are calibrated annually for use in fire tests.

Among the very large number of investigations carried out for submittors of devices and materials, only a few of greatest general scientific interest can be mentioned without extending the length of this paper unduly. The following are typical and illustrate the diversity of problems presented:

Studies of alloys in respect to their general physical properties, their non-sparking properties, and especially their corrodibility under ordinary atmospheric and special exposure.

Studies of protective metallic coatings for iron and steel dealing with their thickness, uniformity, alloying with iron (if any), their single potentials in common electrolytes and their corrodibility in the atmosphere and under various special conditions of exposure. Coatings studied include: Zinc applied by various different methods, lead, tin, terne, cadmium and others. Similar investigations of non-metallic protective coating have also been carried out.

Investigations of numerous materials for their classification and the evacuation of their hazards. Included among such products reported upon are:

Sisal, with particular reference to any liability to spontaneous ignition which it may have.[3]

The fire hazards of various kinds of finely divided carbon used by the rubber, the paint and varnish, the printing and other industries. These investigations bear upon the ignitibility, the combustibility, and the liability to spontaneous heating of the material in shipment and storage. The reports have not been published, but brief advices to Laboratories subscribers, based upon the conclusions reached in the investigations, are on file with all insurance organizations subscribing, and are available at the Laboratories to all inquiring.

A variety of forms of cellulose-acetate-base and other plastics have been studied, and reports covering their fire hazards in shipment, storage and use have been rendered.

So-called "fireproofed" or "flameproofed" textile fabrics for use in draperies for public places, theater scenery, window shades, and other uses, have been studied extensively in respect to their fume or flash-fire resistive characteristics, their speed of flame travel on ignition, the character of fumes emitted under fire conditions, the permanence under dry and wet conditions and other characteristics. Reports upon this class of materials have been issued to their manufacturers only.

Among the materials and devices which have been investigated in the past (for most of which definite standard requirements for the class have been developed) and which are regularly tested in the chemical laboratories in connection with some one of the Laboratories' various forms of follow-up service, may be mentioned:

Roofing materials, of which hundreds of samples are tested annually for compliance with standard specifications.

Zinc-coated rigid electrical conduit and armored cable.

Chemical charges for fire extinguishers of the foam type, the carbon tetrachloride type and various special types including non-freezing.

Foam-producing ingredients for use in foam-type extinguisher systems.

Matches, of both the strike-on-the-box type and the strike-anywhere type.

Glass cylinders for visible-measure gasoline pumps as used in service stations. Standards for the annealing of these cylinders have been worked out by the aid of the polariscope, with the co-operation of the industry, and regular follow-up test work under these standards is being carried on.

Other materials include: Unlined linen fire hose; chemical engine hose; electrolytic oxygen and hydrogen gases; liquefied petroleum gases for cutting, welding, domestic lighting and heating, and similar purposes.

In addition to its regular work as outlined above, the Department of Chemistry is constantly being called upon by insurance boards, bureaus, agencies and companies, and also state and municipal authorities, for information and advice in connection with special hazards, explosions, spontaneous combustion phenomena, and incendiarism. Service as requested, often involving test work, is rendered wherever possible.

The Department is represented upon numerous (more than 30) technical committees of engineering and scientific organizations of national scope, including: The Ntiaonal Fire Protection Association, American Society for Testing Materials, American Standards Association, National Safety Council and American Chemical Society.

Testing Grounds: Building for Tests Involving Poisonous Gases

[2]Underwriters' Laboratories' Report on "Corrosive Action and Nature of Products Formed When Carbon Tetrachloride Extinguisher Liquids Are Applied to Fires," by A. H. Nuckolls, 1920.
[3]Underwriters' Laboratories' Report on Sisal, Oct. 12, 1921.

Technology of Oil Refining Shows Many Advances

By A. D. DAVID
New York, N. Y.

***Editor's Note:** Each year the Petroleum Division of the American Institute of Mining and Metallurgical Engineers selects one of its members to summarize the most important recent developments in refinery technology. This summary is presented before the annual meeting in New York. This year the honor fell to Mr. David, former vice-president of the Continental Oil Company at Denver, and more recently sales manager of the M. W. Kellogg Company, of New York, to whom Chem. & Met. is indebted for the use of the photograph.*

MORE flexible plants, more unified operations, more balanced performance, and greater fuel economy have characterized recent advances in the technology of petroleum refining. Economic pressure has been the controlling factor in this progress, supplemented, however, by a market demand for more volatile anti-knock gasoline and higher quality lubricating oils resulting from the extended use of high compression motors.

Possibly the outstanding achievement during the year has been the beginning of construction of plants by the Standard Oil Company of New Jersey for the catalytic hydrogenation of the so-called heavier and inferior petroleum oils to produce therefrom not only high yields of anti-knock gasoline but also lubricating oils equal in quality to the best grades obtainable. It is reported that the plants will operate at a pressure of 4,000 lb. or higher and that temperatures in excess of 900 deg. F. will be used. The hydrogen required for the conversion will be produced from refinery gases. This type of processing doubtless will be an important factor in balancing future operations; in other words, hydrogenation can be used to eliminate present waste products and to permit production of high-grade products from low-grade crude oil.

Another important development during the past year has been the extended use of vacuum stills, making possible the production of lubricating oils from what was formerly classed as "fuel oil crude," or crude oil from which only fuel residuum could be made. Better separation of the various fractions or lubricating oil distillates now makes it possible to produce pressable wax distillate free from non-viscous gas oil simultaneously with centrifugable cylinder stock and high-melting-point asphalt.

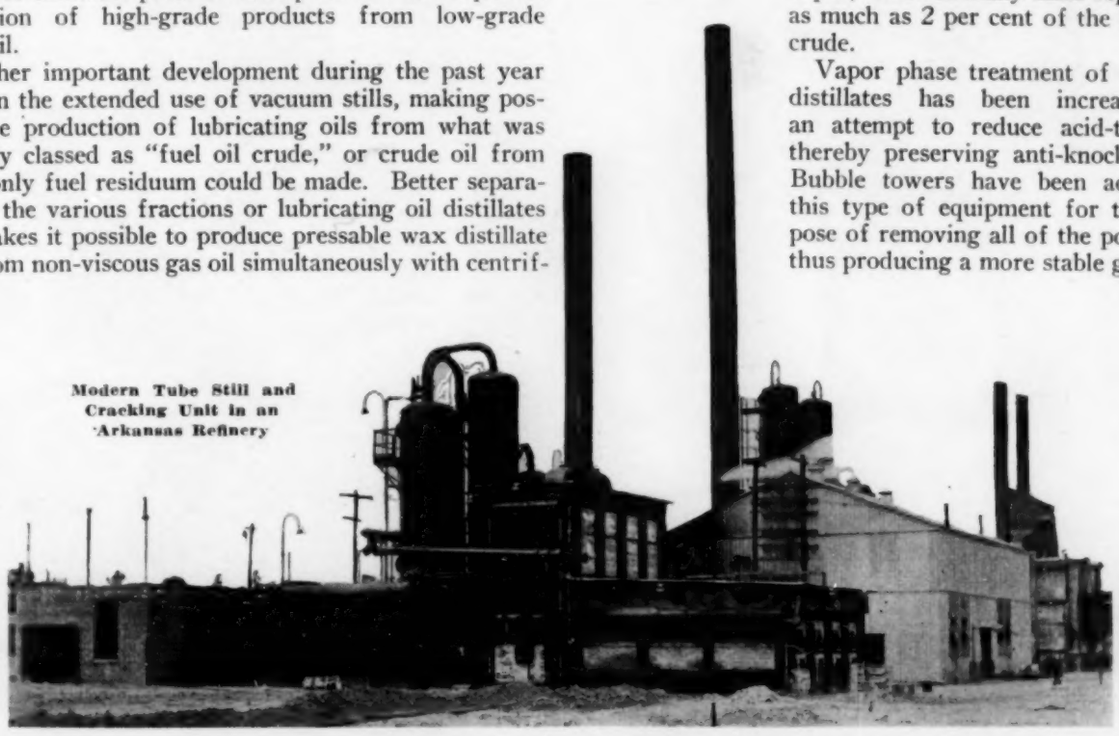
It has been reported that considerable progress has been made in continuous treatment of lubricating oils principally concerned with the separation of acid sludge by centrifuging. In the filtration of the lubricating oils to acceptable colors, the contact filtering operation is being more extensively employed, and the use of continuous earth burners, such as the Wedge and Herschoff types, has increased the efficiency and reduced the cost of clay recovery.

Another remarkable advance of the past few months has been the rapid commercialization of vapor phase cracking. This has been given attention primarily because of the increased demand for anti-knock gasoline. Operating cycles have been lengthened, resulting in greater economy, which, together with a material reduction in quantity of gas produced, makes this type of operation more practical.

Liquid phase cracking units are now being built which are capable of producing gas, gasoline, and coke only, thus eliminating the production of fuel oil which, due to overproduction, demands a very low price. The coke formed, in many cases, is being pulverized and used for fuel in the same unit. Where it is essential to produce fuel oil, much work has been done on the elimination of coke, resulting from cracking, with the result that some outstanding units produce little, if any, coke.

Attention is now being directed toward the reduction of gas losses from refinery operation. Absorption and stabilization plants have been erected in conjunction with topping and pressure units to recover the gasoline contained in the residual gases, in addition to eliminating the dissolved gases in the gasoline produced. By means of such installations, losses in storage and due to handling in tank cars and station tanks have been reduced. Some of these units have been installed in conjunction with cracking equipment, utilizing waste heat from cracking operations to reboil the gasoline from the base of the stabilizer tower. The recovery of gasoline from pressure still gases averages from 3 to 5 gal. per 1,000 cu.ft. of vapor, which in many cases represents as much as 2 per cent of the original crude.

Vapor phase treatment of cracked distillates has been increased in an attempt to reduce acid-treating, thereby preserving anti-knock value. Bubble towers have been added to this type of equipment for the purpose of removing all of the polymers, thus producing a more stable gasoline.



Modern Tube Still and Cracking Unit in an Arkansas Refinery

Arc Welding Used for Large Gas Line

PRESENT INTEREST in natural gas and long-distance transmission lines is no mere flurry, witness the enormous amount of line construction now going on. One of the more important of the lines recently completed is the Uinta Pipe Line Company's new arc-welded line from the junction of gathering lines which is southeast of Rock Springs, Wyo., to Ogden and Salt Lake City, Utah. The total length of the line is reported to be about 277 miles. Of the total mileage, 200 miles is of 18-in. pipe, the balance being of 16-in. pipe consisting of a 42-mile branch to Ogden and a 35-mile branch to Salt Lake City. This is the first 18-in. line to be arc welded.

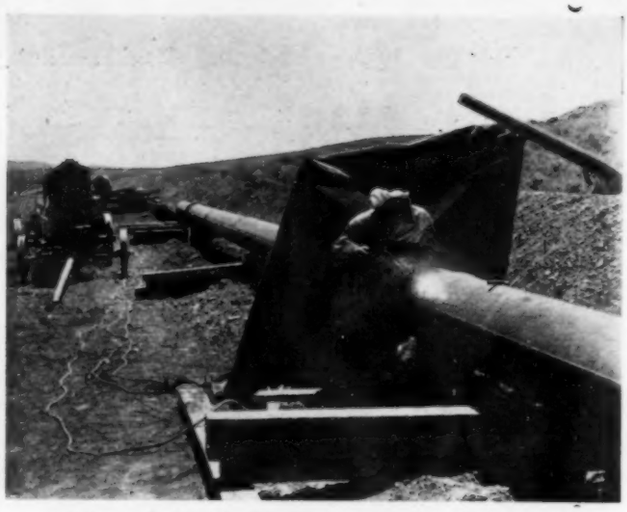
The pipe used is of arc welded manufacture produced in 30-ft. lengths having bell and spigot ends with welding dams. Each length weighs 1,600 pounds. Due to the ruggedness of the country and the steep grades encountered, some of the pipe had to be snaked into position by tractor, after having been delivered as near location as possible by truck. Some idea of the nature

On This 60 Per Cent Grade, Sections of Pipe Were Welded on the Hilltop and Lowered Into Place

of the country traversed by this line may be obtained by observation of the view above which shows a completed portion of the line on a 60 per cent grade.

The customary practice of lining up a number of lengths of pipe to form a section has been followed in constructing this line. After the pipe is lined up and leveled in sections, each joint is tack welded. By tack welding, the pipe lengths are joined so that contraction and expansion acts on the section as one unit instead of as separate pipe lengths.

Each joint in the section is arc welded twice, two separate beads being run around each joint. This is done to prevent all possibility of pin-hole leaks. The first, or burning-in bead, is arc welded with $\frac{5}{16}$-in. electrodes. Approximately $\frac{3}{4}$ lb. of electrode metal was used



Using a Tarpaulin as a Windbreak on a Windy Day

to weld the burning-in bead in the 18-in. joints on this line. The second, or finish, bead is arc welded with $\frac{1}{4}$-in. electrodes, approximately $1\frac{3}{4}$ lb. being consumed in making the finish weld. On the firing line, which is the scene of welding the pipe lengths into sections, welding speeds ranging from 8 to 12 joints per man per day were obtained on this job. Typical firing line scenes are shown in the illustrations.

After the pipe is welded into a section, the section is then placed over the open trench on skids and welded into the line. This welding is known as bell-hole welding. Being unable to turn the line, the operator must weld around the pipe, necessitating overhead welding. Only in this respect does bell-hole welding differ from firing-line welding. The speed of welding bell-hole joints of this line varied from six to eight joints per operator per day.

To take care of the expansion and contraction of the finished line caused by temperature changes, a special type of expansion joint of all-steel construction was welded into the line at intervals.

The major portion of the line has been arc welded by the owners, the Uinta Pipe Line Company, who used ten of the Stable-Arc welders made by the Lincoln Electric Company. These are of the gas-engine-driven type of 300 amperes capacity.

Welding Operations Hidden From View by Windbreaks in This Typical Firing-Line Scene

Corrosion Symposium A Feature of T.A.P.P.I. Meeting

EDITORIAL STAFF REPORT

THE Technical Association of the Pulp and Paper Industry held its fifteenth annual convention Feb. 17-20 in New York City. A large number of the technical men of the industry registered, met in groups, and heard papers presented on the subjects of particular interest to each. Several groups met for luncheon and informally discussed their problems. Records were purposely avoided at these informal sessions, to encourage keener and more frank discussions. The customary formal dinner was dispensed with this year in favor of a general luncheon, which was a great success. President Glatfelter presided, and forceful addresses were made by Otto Kress, H. K. Benson, and Roderick Olzendan.

One of the most important gatherings of the convention was the corrosion symposium. Corrosion is particularly troublesome in the sulphite mills and to lesser extents in the sulphate and soda mills. Recent developments of chromium-nickel alloys, resulting in more easily workable and lower priced corrosion-resisting materials, brought about the appointment, a year ago, of a committee to study the corrosion problems of the pulp and paper industry. J. D. Miller, of the York Haven Paper Company, and chairman of the committee, reported that it is difficult to give an accurate estimate of the magnitude of this particular problem in the sulphite industry. Last year the committee sent out a questionnaire, requesting information on the value of the corrosion loss expressed in dollars per year per ton daily production. The average of the values reported was $98.75. For example, a mill rated at 50 tons per day would have a replacement bill of $4,937.50 annually. To this figure must be added the labor charge and loss in production, which would appreciably increase the above figure.

Interest in the ferrous alloys is shown by the survey from which the following is taken, indicating the percentage of contributors who investigated the alloys at the specific points: Burner gas to cooler, 8.6 per cent; cooking-acid pump body, 2.9 per cent; acid valves, 5.7 per cent; relief valves, 5.7 per cent; gas fan, 2.9 per cent; acid-pump impeller, 11.4 per cent; digester-head-liner, 2.9 per cent; blow lines, 14.3 per cent. The industry apparently is feeling its way on these alloys. In many cases, results from the ferrous alloys have been irregular. These irregularities may be traced in part to metal variation, since the alloys are greatly influenced by the thermal treatment following fabrication. Cases of apparent electrolytic action having caused failures are on record. This point is worthy of careful investigation, under operating conditions, as ultimately the problem of a satisfactory joining of the alloys to non-ferrous alloys must be solved.

Ferrous alloys of the 18-8 chromium-nickel type, with or without molybdenum, have demonstrated that when properly prepared, they represent the best metals offered to date for resistance to sulphite corrosion, reports Chairman Miller. Continued progress in the technology of these alloys may permit the sulphite equipment to be a permanent installation, with replacements negligible as compared to present practice. The initial cost will be high but warranted in the light of attendant advantages.

Manufacturers of corrosion-resistant materials have been invited by the committee to co-operate with it in investigating their products when applied to sulphite conditions, in the corrosion-chamber test. Responses to this invitation have been most gratifying.

Andreas Christensen, sulphite superintendent of the Rhinelander Paper Company, presented a very interesting paper in which he discussed his corrosion experiences. He stated that sulphite mill operators had been faced with the problems arising from the highly corrosive action of hot calcium and magnesium-bisulphate cooking liquor. To handle sulphur-dioxide gas and cooking acid at low temperatures is a comparatively simple matter. Lead fittings, properly installed, will give long service with little attention. When it comes to digester fittings, and auxiliary equipment in connection with the digester operations, where the cooking liquor is handled at temperatures as high as 150 deg. C., the operator is faced with an entirely different problem.

Christensen has had an opportunity to give two of the ferro-alloys a thorough working test over a period of two years, and the data submitted in his paper are based on results obtained in the mill rather than in laboratory experiments. In composition, alloy No. 1 belongs to the high-chromium iron group and will show an analysis of approximately: chromium, 25-30 per cent; manganese, 1 per cent; nickel, 0.5 per cent; silicon, 0.5 per cent; carbon, 0.25 per cent. Alloy No. 2 belongs to the "18-8" group.

TO GIVE the metal a thorough test under the most severe working conditions, a 2-in. bronze-body relief valve fitted with disk and seats made from alloy No. 1 was installed on the head of a 15-ton digester. After ten months of continuous service the valve body gave out and was replaced with a new one. The disk and seat, which showed no sign of wear, were transferred to the new valve. This valve lasted about nine months, and again the disk and seats were transferred to a new valve, where today, after about two years of continuous service, these parts show no sign of being attacked by the hot relief gas and liquor. In a similar manner tubing made from alloy No. 2 was tested. A piece of standard weight with flanges of the same metal was placed in a relief line next to the same digester. This pipe has now been in use for 15 months and gives no indication of wear. During this time it has handled all the relief from a digester with a capacity of 15 tons per blow. The results obtained in these and numerous other tests were considered so satisfactory that during the past twelve months all small fittings about the digesters, the entire system of relief, test lines and gage piping, as well as numerous other pipes and fittings, have been changed from copper and bronze to a ferro-alloy.

Owing to the high cost of complete valves made from this metal, bronze valves have been continued in use in sizes larger than 1 in. These valves are fitted with disks and seats, and in some instances stems, made from the special alloys. There is some indication that the life of the bronze-valve bodies is shortened by electrolytic action. To guard against this possibility Christensen

states that he is changing over more and more to fittings made entirely from this metal, except where the cost is prohibitive.

Some of the principal uses to which ferro-alloys have been put in this mill are as follows: relief, gage and test-line piping; disks, seats, and stems in valves handling hot cooking acid and relief gas; digester plugs and strainers; digester-cover liners; plug cocks for test and gage lines; blow-pit drainer bottoms; pump shafts; bolts in acid tanks and blow pits; pins in swing-checked valves. In addition to these, the alloy is finding its way into other departments of the mill where it is essential to use metals of high resistance to corrosion.

The prices of these alloys are higher than those of copper alloys, and when in addition the higher cost of machining is added, the initial cost of fittings made from these metals will average twice that of bronze. The maintenance cost per ton of paper is the figure in which the operator is interested. This is impossible to determine, however, until the ultimate life of the metal is known.

Other items to be considered in figuring costs include better control of the digester operation by eliminating the possibility of losing gas through leaky valves, and the fact that drainers remain clean and need be inspected only when repairs are made to linings.

Walter M. Mitchell, of the Central Alloy Steel Company, discussed the problems of corrosion in the pulp and paper industry from the viewpoint of the metallurgist and manufacturer. He stated that centrifugally cast tubing of large size is a commercial possibility in the near future. Bronzes, cast iron, Monel metal, etc., have been successfully cast in tube form by this method, and there appears no reason why chrome-nickel-molybdenum alloys cannot be similarly handled. The structures and physical properties of centrifugally cast metals are notably better than those of still castings. Sizes in bronze tubing have run up to 24 in. diameter and 20 ft. long. It may be possible also to cast flanges integral with the tube in itself, thus doing away with welding or expanding. Tubing of this character will be suitable for blow lines, and should give longer life than the cast-iron pipe now in use.

Fabrication of a full size digester of chrome-nickel-molybdenum alloy is not an impossibility. Riveting is to be preferred to welding as a means of construction, because of the obvious impossibility of heat-treating any piece of equipment the size of a digester after fabrication. To avoid questionable qualities in the metal itself and possible undesirable results of fabricating procedure, very low carbon should be specified for both plates and rivets, according to Dr. Mitchell. Both the plates and the rivet materials should be heat-treated before fabrication. The chief advantages of an alloy digester will be a material reduction in corrosion troubles and elimination of the brick lining.

T. H. Nelson, a consulting metallurgist in his paper, "What Constitutes a Desirable Corrosion Alloy for the Sulphite Industry?" stressed the fact that where conditions of severe corrosion occur, the results are extremely erratic where the residual iron content of the alloy exceeds 70 per cent. He stated that the resistance of the 18-8 type of alloy could be improved by the addition of molybdenum, silicon and other materials. Such metals usually are used to the extent of 2 to 3 per cent, thereby producing a final alloy with a residual iron content of approximately 70 to 72 per cent.

The improvement in resistance is perhaps not so much dependent upon the three or four alloys added as upon the reduction of the amount of residual iron present. However, in particular instances, such as in the addition of molybdenum and tungsten, these metals have the ability in conjunction with chromium or chromium and nickel to increase the passivity or insolubility of the ultimate alloy to a very marked extent. There are instances where 14 per cent of chromium with 2 per cent of molybdenum or tungsten will often perform equally as well as 20 or 22 per cent of certain chromium alloys. Dr. Nelson's experience leads him to believe that the alloy giving the most consistent results in respect to resistance to corrosion in the sulphite industry is one in which the residual iron content is not more than 65 per cent. The alloy most suitable for use in this industry is one containing 20 to 25 per cent chromium, 8 to 10 per cent nickel, with the addition of silicon or molybdenum. This type of alloy, continued Dr. Nelson, so far, has given more consistent results than the type of material with a lower alloy content.

Inspection and insurance of pressure vessels in the paper industry was the subject of an interesting paper by William D. Halsey, of the Steam Boiler Inspection & Insurance Company. He pointed out that disastrous accidents had occurred in connection with digesters and other pressure vessels, due to the corrosive action of the sulphite liquor. He also indicated what conclusions had been reached as a result of investigation of the causes of these accidents, and the precautions to be taken to avoid repetition of such accidents.

Sulphite Mill of the Washington Pulp & Paper Company, Port Angeles, Wash.

Brubaker Aerial Surveys, Portland, Ore.

Is SMOKE Responsible for Property Damage?

By R. D. MacLAURIN
Commissioner of Trade Waste, City of Cleveland, Cleveland, Ohio

Certainly, says Dr. MacLaurin, and everyone will agree with him. But he has done more than talk about it. He has determined the size of smoke particles in city air, has shown the damage that is done by the particles, and has proved conclusively that collection of smoke at its source is the real solution to the question of air pollution. Here is a problem in chemical engineering the ultimate answer to which will save property owners—and we are all property owners—millions annually. In a later issue of *Chem. & Met.*, Dr. MacLaurin will describe the methods of collecting smoke at its point of origin.

A MAJOR PURPOSE of this article is to demonstrate that atmospheric pollution due to smoke particles in suspension, which range in size from 0.2 to 1.5 microns (a micron is one thousandth of a millimeter), is responsible for property damage to the exterior of buildings, to merchandise in stores, and to interior decorations in homes. Further, it will be demonstrated that the most direct and efficient method of preventing such property damage is to collect smoke at the source of its origin.

The demand for clean air in our cities will not be appreciated as sufficiently imperative until it is realized that there is a necessity for pure air comparable to the demands for pure water and pure foods. Bearing that thought in mind and recalling, further, that the daily consumption of air by the human body is more than four times by weight that of our liquid and solid foods combined, we cannot fail to realize that such air should be clean and wholesome. However, since the consumption of dirty air is not fatal, our attention will be confined to a study of visible manifestations of various kinds of property damage caused by microscopic smoke particles. Atmospheric pollution in large cities has increased to such an extent that owners of merchandising and other buildings, including homes, are resorting in rapidly increasing numbers to cleaning air for ventilating purposes.

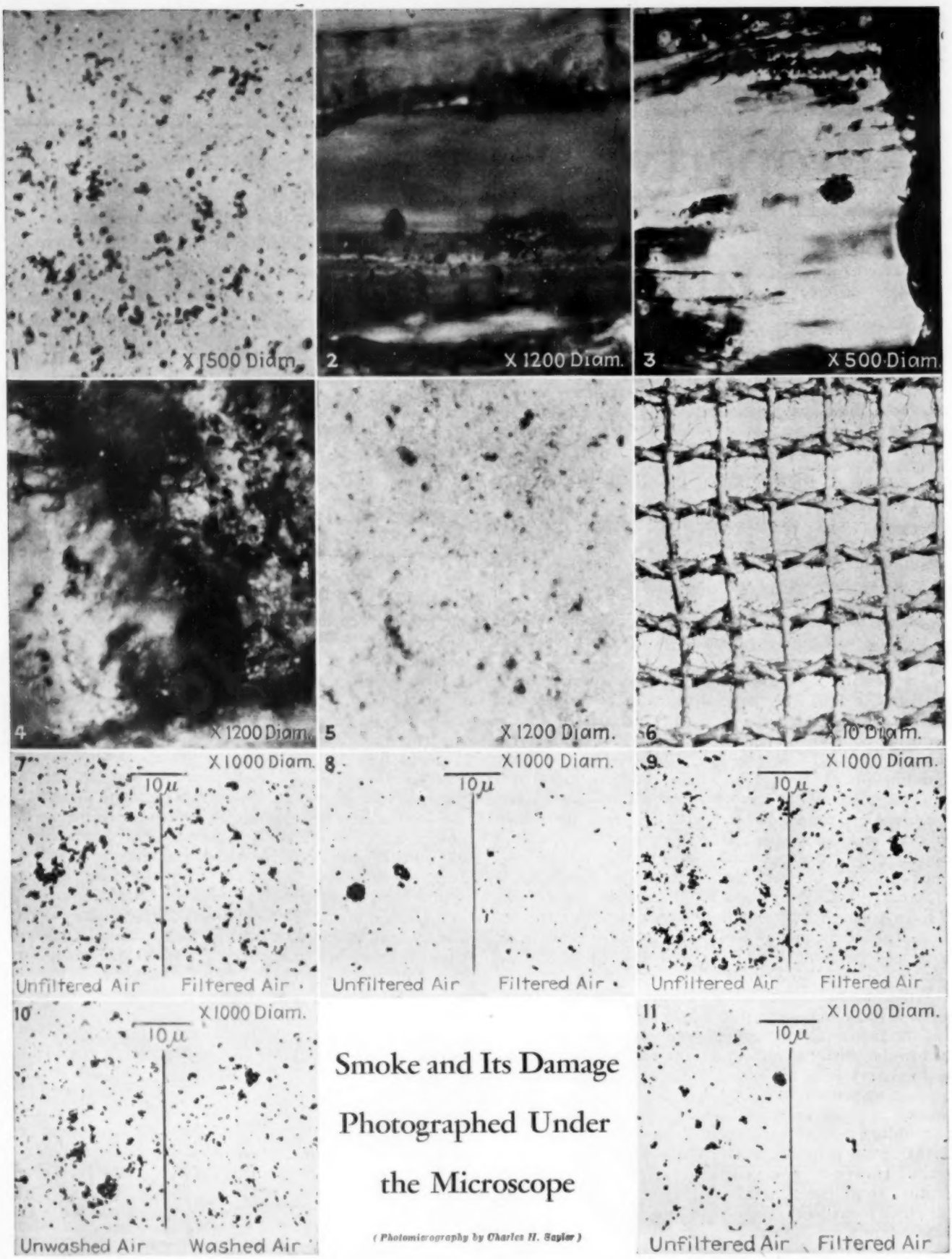
When smoke is emitted from chimneys into the atmosphere it becomes dispersed in a very large volume of air, and thereafter the microscopic smoke particles remain in suspension chiefly as individual entities. In other words, there is very little tendency for microscopic smoke particles in suspension to coalesce and form larger particles. Smoke particles in suspension in city air constitute a very dilute aerosol ranging in density from 0.0001 to 0.0006 grain per cubic foot, or averaging about 0.0004 grain. However, the concentration of smoke particles as emitted from power plant chimneys is about 4 grains per cubic foot of air. As a cubic foot of city air contains 0.0004 grain of smoke, and smoke as emitted from power-plant chimneys contains 4 grains per cubic foot of air, it is obvious that there are 10,000 times as many grains of smoke in air per cubic foot at the source of its origin as obtains in air after partial dilution.

If smoke that is emitted into the air were to be collected subsequent to dilution, it would necessitate the cleaning of a volume of air 10,000 times greater than would have been necessary had the smoke been collected at its source. This calculation has been made merely for the purpose of illustrating the wide variation in the concentration of smoke particles encountered in air cleaning for ventilating purposes compared to that in collecting similar smoke particles at the source. Furthermore, it is much more difficult to clean air subsequent to dilution of smoke particles than prior to dilution, owing to the fact that in the former case the smoke particles are in suspension as individual entities, whereas in the latter case the particles are much more concentrated and as a consequence are more easily collected. There is no difficulty in collecting smoke at its source either by electrical precipitation or bag filtration. The latter method is rapidly being recognized as eminently satisfactory.

As the art of air cleaning for ventilating purposes is making rapid progress, it is advisable to analyze the prerequisites necessary to accomplish the desired results in preventing property damage. It is obvious that air cleaning for ventilating purposes has no bearing on the prevention of property damage to the exterior of buildings or vegetation. It is equally obvious that such property damage can best be prevented by collecting smoke at the point of its origin. Although some relief can be secured from property damage to interior decorations and merchandise by air cleaning, such anticipated relief can be obtained only if adequate air-cleaning equipment is employed. Therefore, prospective purchasers of air-cleaning equipment who desire clean air must consider the following essential factors:

1. What is the size of smoke particles which are in suspension in air and cause property damage?
2. What type of air-cleaning equipment must be employed so that smoke particles will be collected and, as a result, prevent property damage?

The size of smoke particles which remain in suspension in air and cause property damage varies from 0.2 to 1.5 microns. These smoke particles are illustrated by



(1) Smoke Particles in City Air, Average Size 0.6 Micron; (2) Silk Damaged by Smoke Particles; (3) Silk Shirt Cuff Damaged by Smoke Particles After One Day's Wear; (4) Wall Paper Suffers From Smoke-Particle Damage; (5) Even a Painted Wall is Damaged; (6) Low Magnification Proves Curtain Injured by Smoke Particles; (7), (8), (9) Air Before and After Passage Through Oil Filter; (10) Water Washing Is No More Efficient Than Oil Filters in Removing Microscopic Particles; (11) Fabric Filter Shown Much More Effective Than Oil Filters and Water Washing. (7)-(11) Each Represent 0.1 C.C. Air.

the photomicrograph shown in Fig. 1. This represents smoke particles in suspension in air, the average size of which is 0.6 micron. The particles are magnified 1,500 diameters. Having thus illustrated the size of smoke particles in suspension in air, the next question is, do these microscopic particles cause property damage?

That such microscopic smoke particles as those illustrated do cause property damage is evidenced by Fig. 2, in which microscopic smoke particles have damaged a sample of silk. This sample was suspended in air in the center of the writer's office for several months. From the photomicrograph it will be observed that there are four filaments of a silk thread covered with microscopic smoke particles which have been magnified 1,200 diameters. It is evident that these microscopic smoke particles which have damaged the silk are the same size as the smoke particles in suspension in air illustrated by Fig. 1. In other words, this photomicrograph conclusively establishes the fact that microscopic smoke particles suspended in air do cause property damage.

Photomicrograph number 3 is one of a silk shirt cuff taken after the cuff was worn for one day in Cleveland. It will be observed that the microscopic smoke particles in this photograph have been deposited so closely together that they form a continuous film of dirt. In the center of the photomicrograph small particles magnified 500 diameters are in evidence. This damage also is due to smoke particles in suspension which are of the same order as those previously illustrated.

The photomicrograph shown in Fig. 4 represents smoke particles deposited on wall paper and magnified 1,200 diameters. It will be observed that the smoke particles are of the same range of size as those illustrated in Fig. 1. In other words, the microscopic smoke particles which remain in suspension in air have deposited on the wall paper and caused property damage.

A similar condition appears in Fig. 5, which represents microscopic smoke particles deposited on a painted wall and magnified 1,200 diameters. Here again it is apparent that the particles deposited on the painted wall are of the same range of size as those which remain in suspension in air, and agani have caused property damage.

We need not employ such high magnification to detect property damage. The photomicrograph in Fig. 6 is of a curtain magnified 10 diameters. This curtain was damaged as a result of smoke particles having been blown off a neighboring roof into an adjoining open window in which the curtain was hanging. The damage in this instance was caused by particles of a wider range in size than those illustrated in the previous photographs. Here the particles range from 0.2 to 100 microns.

Without making any attempt to place responsibility on microscopic smoke particles less than 1 micron in size, for the major part of property damage, it will suffice for the present to recognize that property damage *is* actually caused by smoke particles of less than 1 micron as well as by particles up to 50 or more microns.

WITH the fact established that microscopic smoke particles suspended in air cause property damage to merchandise and interior decorations, the question now arises, how can such property damage be prevented? Obviously, if part of the damage is to be prevented by air cleaning, it will be necessary to employ air-cleaning equipment that will collect microscopic dust particles. In other words, the efficiency of air-cleaning equipment must be determined by its ability to collect smoke particles of less than 1 micron in size.

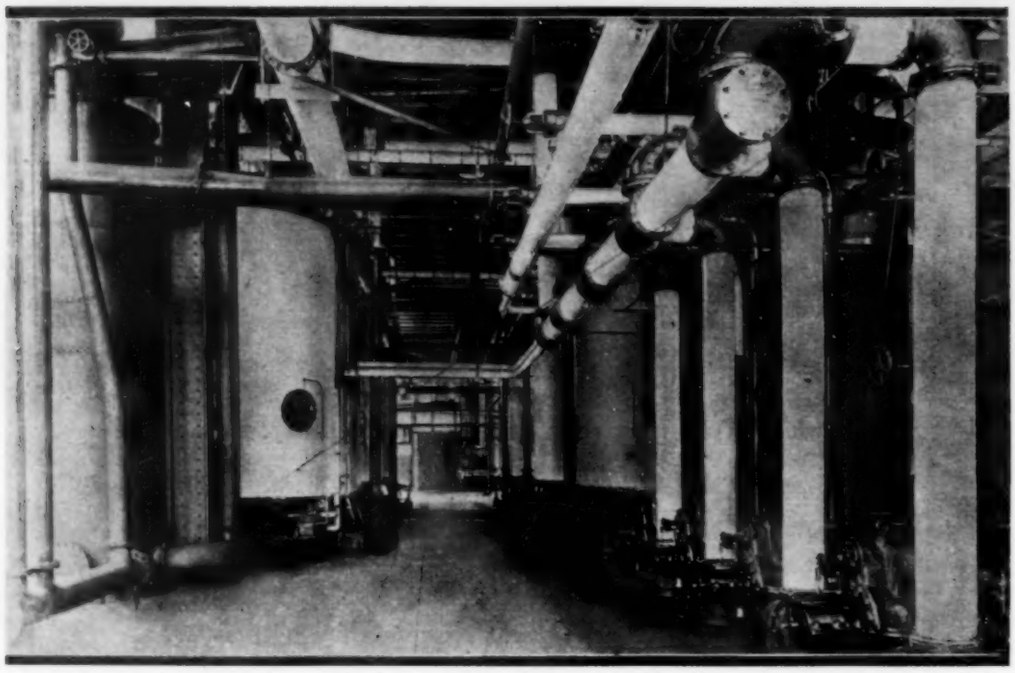
Thus having imposed certain prerequisites on air-cleaning equipment which may be used for ventilating purposes, it is of interest to consider the following photomicrographs: Figs. 7, 8 and 9, which illustrate efficiency tests made on oil filters; Fig. 10, on a water washer; and Fig. 11 on a fabric filter, all of which are being used for air-cleaning purposes in Cleveland.

The first three photomicrographs of this series represent the air-cleaning efficiency or, in other words, the ability of oil filters to remove microscopic dust particles from air. The fourth represents the air-cleaning efficiency of water washers, and the fifth, the air-cleaning efficiency of a fabric filter. A cursory examination of these photomicrographs reveals the fact that oil filters and water washers do not remove any appreciable quantity of smoke particles suspended in air, which are less than 1 micron in size. The air samples in the efficiency tests were taken by means of Owens' Jet, and the smoke particles in each are magnified 1,000 diameters. (The original microphotographs were magnified 1,200 diameters, but the magnification as reproduced is 1,000 diameters—*Editor.*) The smoke particles on either side of the vertical line in the photomicrographs represent the number of smoke particles in 0.1 cu. cm. of air.

Although oil filters and water washers do not recover any appreciable percentage of smoke particles from air, they do recover large dust particles and therefore render a service. Further, these inexpensive filters have rendered an indispensable, educational, air-cleaning service in the past which has paved the way for the use of more efficient air-cleaning equipment which undoubtedly will find a more ready sale in the future.

WHAT then are the prerequisites of a dry filter suitable for air cleaning? Obviously, the first prerequisite is that the filter medium shall collect a large percentage of all dust and smoke particles which constitute air pollution. In fact, the efficiency of a filter should be determined by its ability to collect a large percentage of the small smoke particles which range in size from 0.2 to 1.5 microns. Another prerequisite of a satisfactory air-cleaning filter is that the filter medium shall have a large storage or retention capacity for smoke and dust particles, so that the filter may be operated for a considerable period of time without any appreciable increase in resistance to air flow. We have determined that a filter which possesses high porosity and an effective filtering surface 100 times that of its linear surface will remove 90-95 per cent of smoke particles from air as determined by Owens' Jet method.

The photomicrographs which have been submitted here, showing microscopic smoke particles adhering to various kinds of material, constitute incontestable evidence that smoke particles suspended in air, and ranging in size from 0.2 to 1.5 microns, do cause property damage. Furthermore, the quantity of smoke particles which remains in suspension in air greatly exceeds that which settles out due to gravitation, as evidenced by the fact that city air contains from 3,000 to 10,000 or more per cubic centimeter of such particles as are illustrated in Fig. 1. The recognition of these facts is imperative in order to comprehend the prerequisites of air-cleaning equipment, so that property damage may be abated. When these facts are more fully appreciated by manufacturers and users of air-cleaning equipment, the art of air cleaning will advance and the conception that air pollution can best be prevented by collection of smoke at the point of its origin will gain public recognition.



Evaporators in a Modern Industrial Alcohol Plant

The FACTS *About* INDUSTRIAL ALCOHOL

By WARREN N. WATSON

Chief, Chemical Division, U. S. Tariff Commission, Washington, D. C.

ETHYL ALCOHOL ranks first in quantity and value of production of all organic chemicals. It is a basic raw material in the chemical and process industries and finds application in a multitude of products. An approximate distribution of denatured alcohol by uses is as follows:

	Wine Gallons
Anti-freeze	40,000,000
Cellulose industries	25,000,000
Shellac and varnish	8,000,000
Toilet and perfume preparations	5,000,000
Miscellaneous	15,000,000

In addition, pure alcohol (not denatured) is used in pharmaceuticals. The total of such tax-paid pure alcohol withdrawn in 1928 was over 4,500,000 wine gallons.

The total available capacity in the United States for producing alcohol is about 220,000,000 wine gallons, of which about 15,000,000 wine gallons is for production from grain, and the balance, 205,000,000 wine gallons, from molasses. The annual consumption is about 100,000,000 wine gallons, or somewhat less than one-half the present capacity. The capital invested in molasses alcohol plants is about $55,000,000 and in grain alcohol plants about $5,000,000.

Molasses alcohol plants are located on the coast; the principal plants are at or near New York, Philadelphia, Baltimore, New Orleans, San Francisco, and Boston. The four leading states producing alcohol from molasses in order of their importance are: Louisiana, Maryland, Pennsylvania, and New Jersey. The molasses alcohol industry is equipped, organized, and located for the use of molasses as a raw material for the manufacture of alcohol. The three large grain alcohol plants now operating are located at Pekin, Ill.; Laurenceburgh, Ind.; and Cincinnati, Ohio. The annual grain alcohol capacity of these three plants is about 15,000,000 wine gallons, equivalent to about 6¼ million bushels of corn per year. The production of these plants is estimated at less than 5,000,000 gal. per year, equivalent to about 2,800,000 bu. of corn. (In addition, there is one idle plant at Peoria with a reported capacity of about 4,000,000 wine gallons.)

During the last twenty years there has been a shift from corn to blackstrap molasses as the principal raw material for alcohol, as is well shown in Table II.

In commercial practice one bushel of corn yields about 2.4 wine gallons of alcohol, and 2.7 gal. of blackstrap molasses yields about 1 wine gallon of alcohol. In other words, one bushel of corn is equivalent to nearly 6½ gal. of blackstrap molasses.

The conversion cost of alcohol made from corn is about 3 to 5c. more per gallon than from molasses. The approximate cost for converting molasses to alcohol is 7c. per gallon of alcohol, and for corn 10.5c. per gallon of alcohol. In the case of corn, the byproducts constitute an important credit which is discussed later. Production

Table I—Denatured Alcohol Production

Fiscal Year	Wine Gallons	Fiscal Year	Wine Gallons
1907	1,780,276	1923	57,565,142
1908	3,321,451	1924	67,687,295
1909	4,556,418	1925	81,808,273
1910	6,079,027	1926	105,375,886
1911	6,881,129	1927	95,448,676
1912	8,094,515	1928	92,418,025
1922	33,345,747	1929	106,960,458

Table II—Corn and Molasses Used in the Manufacture of Alcohol.

From Report of Commissioner of Internal Revenue and Commissioner of Prohibition

Fiscal Year	Corn, *Bushels*	Blackstrap Molasses, *Gallons*
1910	20,547,427	42,293,073[2]
1912	23,016,759	61,605,281
1916	32,069,542	152,142,232
1921	4,810,517	118,363,629
1926	7,948,184	267,404,218
1927	8,383,041	211,518,647
1928	6,189,264	213,629,806

costs for large plants, either corn or molasses (alcohol plants), running at or near capacity is less than the above figures. Table III shows the cost of producing alcohol from corn and from molasses for large plants at or near capacity operation. These costs would be considerably increased when the operation is at 50 per cent capacity and, furthermore, the costs for small plants also would be more.

In the manufacture of alcohol from corn, the byproducts consist of distillers' grains, a valuable cattle feed, which has sold in recent years for from $35 to $45 per ton, or on an average of about 2c. per pound. Each bushel of corn gives about 12½ lb. of distillers' grains. In addition, fusel oil is another byproduct of small importance, and in certain cases, corn oil and corn oil meal are obtained. The credit for byproducts amounts to about one-fifth of the gross cost and for capacity operation may exceed the conversion cost. It is estimated that if all the alcohol produced in America was made from corn, the production of distillers' grains would amount to from 225,000 to 250,000 tons. It is problematical whether with this increased output the price of distillers' grains would remain at the present level of about 2c. per pound. If this price should decline, it would be reflected in an increased cost of producing alcohol from corn.

ASSUMING it were commercially feasible to convert the molasses plants to grain alcohol plants, an additional capital investment would be required of at least $10,000,000, or an additional investment of 10 to 20c. per gallon capacity. The location of these molasses alcohol plants on the coast, however, is unfavorable to the use of corn because of the high transportation costs. The freight on corn from Iowa to New York is 27.5c. per bushel. The freight on corn from Iowa to the West Coast is 42.5c. per bushel and from Cairo, Ill., to New Orleans (by water) is 11.4c. per bushel. In other words the freight cost on corn alone for plants located at New York is about 10c. per gallon of alcohol produced, and in the case of plants at New Orleans about 4.6c. per gallon. In order to supply the total domestic consumption of alcohol from corn, additional plants would be necessary in the corn belt, with an investment of about $30,000,000.

Table III—Cost of Ethyl Alcohol Production

(Per wine gallon)

	Corn		Molasses	
	94c. per Bushel	83¾c. per Bushel	9.5c. per Gallon	6.5c. per Gallon
Raw materials—				
Corn	$0.3670	$0.3280	.....	.....
Molasses	.....	.....	$0.2565	$0.1755
Barley and chemicals	.0501	.0501	.0050	.0050
Total raw materials	$0.4171	$0.3781	$0.2615	$0.1805
Conversion cost[1]	.1054	.1054	.0700	.0700
	$0.5225	$0.4835	$0.3315	$0.2505
Credit byproducts	.1155	.1155	.....	.....
Net cost per wine gallon	$0.4070	$0.3680	$0.3315	$0.2505

[1] Includes total factory expense, insurance, depreciation, and overhead, but does not include selling expense, and cost of denaturization, which amounts to about 2½c. a gallon for completely denatured formula.

The most convincing argument against the investment of capital in new grain alcohol plants in the West is the advent of synthetic ethyl alcohol, which has been already developed on a commercial scale in Europe, while at least two domestic chemical firms have already carried the process through the experimental stage. A permit was granted by the Commissioner of Prohibition to conduct a one month's (May, 1929) commercial test on synthetic alcohol at the plants of the Carbon & Carbide Chemical Company at Charleston, W. Va., and about 48,000 proof gallons was produced. It is understood that this run was a commercial success and that plans are under way for a large scale production of synthetic ethyl alcohol.[1]

Synthetic alcohol can be made from: natural gas, calcium carbide, or ethylene from blast-furnace or coke oven gases. As far back as 1921, one plant in Germany was erected to make synthetic alcohol, with a capacity 500,000 gal. per year, and another plant was erected in Upper Bavaria.

The cost of production of synthetic alcohol in England[2] was reported in 1922 at about 30c. per gallon. Domestic costs of synthetic alcohol are not known. Estimates indicate a cost of 35c. per gallon.

ANOTHER important factor based on the increased cost of raw material for alcohol, whether it be molasses or corn, is the question of substitution of other products for alcohol. The principal use of denatured alcohol is as an anti-freeze, taking about 40,000,000 gal. out of about 90-odd million gallons production a year. Keen competition is now encountered in this field from glycerin and ethylene glycol. Furthermore, synthetic methanol or wood alcohol has been developed on a large scale during the last two years, and this promises to be another competitive factor in the alcohol anti-freeze market as well as in certain uses as solvents in paint, varnish, and chemical industries.

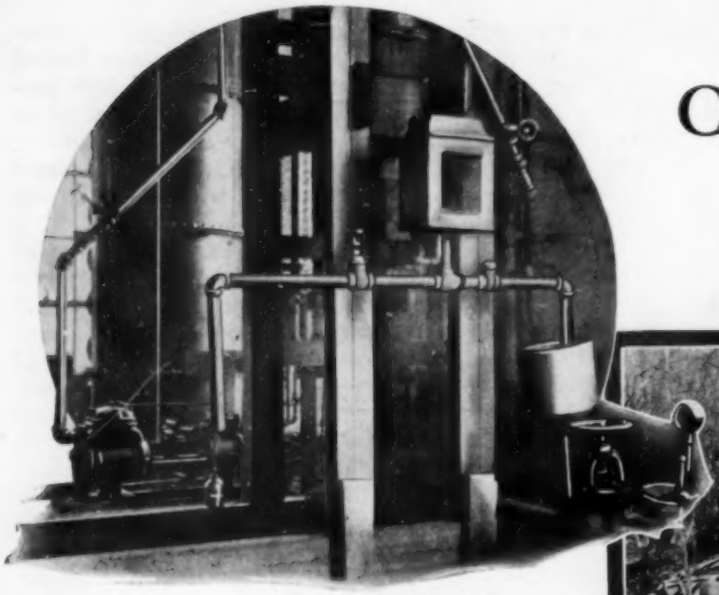
A high duty on molasses would divert molasses from Cuban plants to Europe, where both Germany and Great Britain have established molasses alcohol plants. A high rate of duty on molasses with a subsequent increase in the cost of alcohol would throw entirely out of line many of the rates of duty in the pending tariff bill on alcohol derivatives. The importation of alcohol from foreign countries is not now permitted. Competition, however, from imported alcohol derivatives would result, following any widespread difference in the prices of alcohol in the United States and Europe.

The competition from imported alcohol products might include such items as (1) ethyl acetate, an important derivative of alcohol used as a solvent, the value of which in 1927 amounted to $3,900,000; (2) ethyl ether, the principal anesthetic now in use; (3) pyroxylin products; and (4) certain types of rayon. One domestic rayon plant alone uses about 3,000,000 gal. of alcohol per year.

[1] *The Wall Street Journal* of Sept. 6, 1929 says: "It is understood that Carbide's production will be at the rate of 5,000,000 to 6,000,000 gal. per year, of which 20 per cent will be used in the company's own operations."

[2] *Journal of the Society of Chemical Industry*, May 15, 1922.

Chemical Engineering Contraband



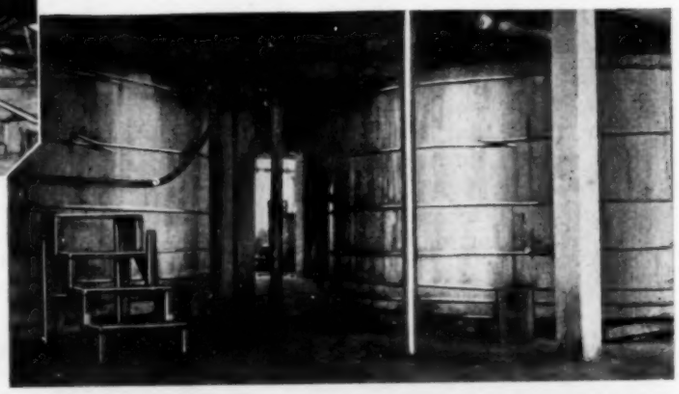
ABOVE: *Fractionating column from an illict still captured by prohibition authorities in a metropolitan district.*

BELOW: *Corn sugar was used in preparing the mash for this moonshine operation.*

Still in the Wood!

Large moonshine plant discovered in southern Maryland

AT RIGHT: *Mash tanks used in a metropolitan distillery.*



BELOW: *A dozen men produced a thousand gallons a day of moonshine in this Maryland still before it was discovered and confiscated by the government authorities.*

Where Does the Bootlegger Get His Alcohol?

By I. D. FOOS
Washington Office of Chem. & Met.

RECENT indictment of corn-sugar manufacturers, yeast companies, and industrial establishments engaged in various branches of the chemical industry has attracted attention to a new phase of alcohol control. There have been three cycles in prohibition enforcement. In its first stage, the authorities concentrated their energies on preventing the diversion of existing stocks of whisky. Next, they turned their attention to checking widespread diversion of industrial alcohol. Now they are attempting to block the movement of otherwise legitimate products to illicit distilleries and hence have brought yeast, corn sugar, and other industrial materials into the prohibition limelight.

Through it all, the manufacture of "moonshine," defended by the Southern highlander as a birthright, has persisted. But as the diverted supply of industrial alcohol has diminished, moonshining has assumed the characteristics and proportions of an industry. The moonshiner's kettle in the swamps and mountains has been supplemented by column stills, operated on a factory scale, located in or close to all the larger cities, particularly in the North. Here corn sugar mash is used in preference to cane and beet sugar, cornmeal, or molasses, because of the rapid fermentation. Usually, it is necessary only to add yeast to this, as the protein content of this type of sugar provides sufficient yeast food so that when accelerated by heat, a ripe mash is produced within 24 hours. Ordinarily, such corn sugar also enjoys a price differential of approximately $1.50 per hundredweight; this, of course, is an advantage, even though cost is not a primary factor in this business.

AS the drive against the diversion of industrial alcohol has continued, seizures made by prohibition agents have revealed that the number of corn-sugar stills is increasing rapidly. Until recently the stills seized were not classified in reports made to headquarters in Washington according to materials used, but since Jan. 1, the Bureau of Prohibition has kept a record of the number of stills seized throughout the country classified according to capacity and the kind of mash used. This record, cited in Table I and based on incomplete reports for the month of January, from 17 out of 27 administrative districts, reveals that one-half of all the stills seized were using corn sugar. Even more significant is the fact that the number of corn-sugar stills of the largest rating according to capacity is an even greater percentage of the total.

Prohibition authorities admit that this is circumstantial evidence, but they contend that the record of seizures truly reflects the situation in illegal alcohol manufacture as it exists today. They claim, furthermore, that this raw material would be still more widely used if as generally available as cane sugar. It is because of the growing importance ascribed to large corn-sugar stills that they are preparing to prosecute the indictments that have been returned against firms supplying corn sugar, yeast, and other raw materials to the distilleries manufacturing illicit liquor on a large scale.

Estimated at one billion pounds last year, the production of corn sugar has increased sevenfold since 1921. (See Table II.) Although improvement of the process for the commercial production of a pure crystallized dextrose from corn sugar is one of the most interesting technical developments in the sugar industry during the past decade, the bulk of production still is confined to lump or "chips" of the sort that have been on the market for many years.

Table I.—Illicit Alcohol Stills Seized During January, 1930, Classified by Capacities and Raw Materials

According to Incomplete Reports Received by the Bureau of Prohibition for 17 Out of 27 Administrative Districts

Capacity		Corn Sugar,	Per Cent of	Cane and Beet Sugar,	Per Cent of	Cornmeal and Other Grains,	Per	Molasses,	Per	Denatured Alcohol and Alcoholic Preparations,	Per
	No.	No.	Total	No.	Total	No.	Cent	No.	Cent	No.	Cent
Less than 100 gal..	807	392	48	308	38	69	9	16	2	22	3
100 to 500 gal.....	603	308	51	223	37	31	5	7	1	34	6
500 gal. or more...	142	91	63	23	16	2	2	5	4	21	15
Total.....	1552	791	51	554	35	102	7	28	2	77	5

Table II.—Production of Corn Sugar in the United States, 1909–1928

Calendar Year	Production (Lb.)	Value
1909.....	159,060,478	$3,600,000
1914.....	174,368,818	.....
1919.....	157,276,442	9,314,977
1921.....	152,055,872	4,542,238
1923.....	537,909,513	16,797,033
1924.....	557,160,516	.....
1925.....	580,370,043	19,505,495
1926.....	696,838,194	.....
1927.....	904,830,682	25,635,262
1928.....	968,600,525	.....

Source: Census of Manufactures, U S. Department of Commerce.

It remains for the pending court cases to bring out and determine the merit of many of the highly controversial features of this business. It can safely be assumed that these cases will be vigorously prosecuted on the ground that producers of corn sugar, yeast, and other commodities have knowingly furnished their materials for illicit alcohol production. One of the important legal questions that will be determined in this connection concerns the responsibility of such manufacturers of a legal raw material under the circumstances.

It probably is safe to conclude that there is something more than coincidence in the statistical relationship which can be noted between the production of the different products involved in these court cases. In the early days of prohibition there was little incentive to go to a new raw material and little appreciation in the bootleg "industry" of the technology potentially involved in its operations. But as pre-Volstead stocks of whisky became less readily available it was natural that the attention of would-be alcohol makers would turn to corn sugar.

The increase in production of this material from approximately 152,000,000 lb. in 1921 to 538,000,000 lb. two years later may not have had any prohibition significance, but the federal authorities certainly believe that the rapid increase which took place after 1926 was of serious import. They point out that this increase of corn-sugar manufacture occurred simultaneously with the voluntary curtailment of industrial alcohol. Furthermore, it is certain that not only this curtailment but also the improvement of denaturing formulas, did much to make more difficult and expensive the reclaiming for beverage purposes of alcohol from either partly denatured or fully denatured forms. All of these claims, of course, have lent considerable strength to the Prohibition Bureau's claim that the jump from 696,000,000 lb. of corn sugar produced in 1926 to 905,000,000 lb. produced the following year had a sinister meaning. In any event, still seizures conclusively prove that the art of bootlegging has taken on many of the improvements which have been currently effective in legal industries which also demand chemical-engineering skill and equipment.

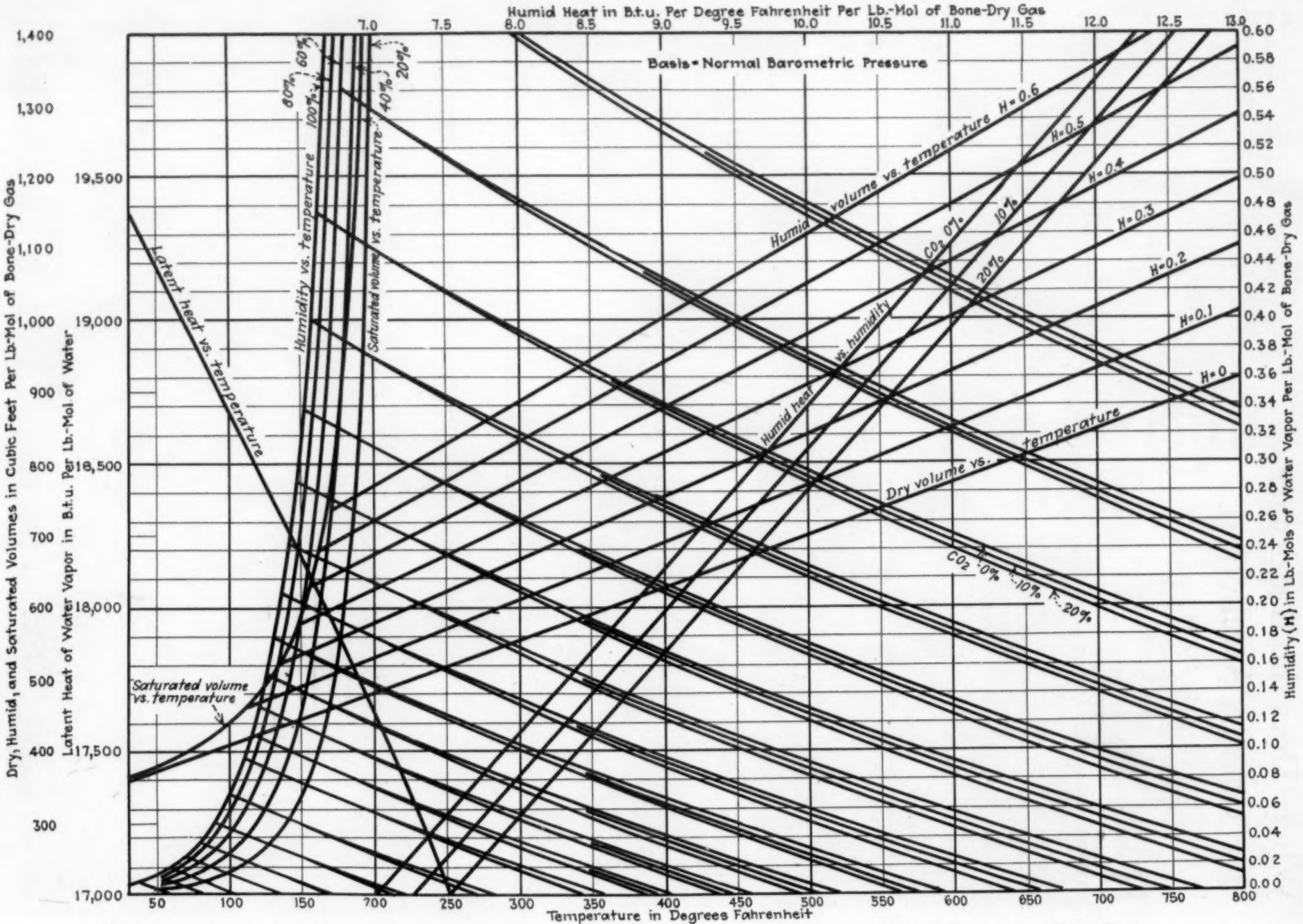

Humid Heat in B.t.u. Per Degree Fahrenheit Per Lb.-Mol of Bone-Dry Gas
Basis - Normal Barometric Pressure
Humidity vs. temperature
Saturated volume vs. temperature
Latent heat vs. temperature
Humid volume vs. temperature
Humid heat vs. humidity
Dry volume vs. temperature
Saturated volume vs. temperature
Dry, Humid, and Saturated Volumes in Cubic Feet Per Lb.-Mol of Bone-Dry Gas
Latent Heat of Water Vapor in B.t.u. Per Lb.-Mol of Water
Humidity (H) in Lb.-Mols of Water Vapor Per Lb.-Mol of Bone-Dry Gas
Temperature in Degrees Fahrenheit

Fig. 1—Revised Form of High-Temperature Psychrometric Chart for Air and Combustion Gases, Based on Pound-Mols of Water Vapor and Dry Gases

New Humidity Chart Simplifies Combustion Gas Problems

By SIROZI HATTA

Assistant Professor, Chemical Technological Institute, Tohoku Imperial University, Sendai, Japan[1]

WIDESPREAD use of the gaseous products of combustion for drying operations in direct contact with the stock being dried makes it desirable to have a graphical method for solution of the problems involved. Humidity charts for air dryers have long been available (e.g., those of W. M. Grosvenor, *Trans. Amer. Inst. Chem. Eng.*, **1**, 184, 1908; W. H. Carrier, *Trans. A.S.M.E.*, **33**, 1309, 1911; and Lavine and Sutherland, *Chem. & Met.*, **35**, 224, 1928), and have not infrequently been employed where combustion gas rather than air was the drying medium. However, the properties of carbon dioxide differ so much from those of air that serious errors are introduced by this procedure. The purpose of this article, therefore, is to present a chart generally applicable to combustion-gas dryers and all cases where the humidity of gaseous combustion products is an important factor.

The usual humidity charts are constructed on the basis of unit weight of bone-dry gas. Because the products of combustion differ so widely in composition, it is almost hopeless to attempt to construct a chart of universal applicability on this basis. If, however, one will keep in mind the fact that the only dry gases encountered in this case, other than carbon dioxide, are oxygen, nitrogen, and carbon monoxide, all of which have substantially identical molal heat capacities, it is clear that the problem is capable of ready solution by construction of a humidity chart on a molal basis. In this, as in so many cases, the use of the mol as the unit of quantity abundantly justifies itself. According to this basis, therefore, humidity[2] is expressed in pound-mols of steam per pound-mol of bone-dry gas; the dry, humid, and saturated volumes are in cubic feet per pound-mol of dry gas; the humid heat is in B.t.u. per degree F. per pound-mol of dry gas; and the latent heat in B.t.u. per pound-mol of steam.

IN CONSTRUCTING Fig. 1, vapor pressures and latent heats are taken from Marks and Davis' "Steam Tables." The molal heat capacities both of the gases and of steam are taken from the results of the equations of Partington and Shilling ("Specific Heats of Gases," pp. 204-5, 1924), using in each case as an approximation the mean value from 0 to 400 deg. C.; that is, 7.01 for O_2, N_2 and CO, 9.55 for CO_2, and 8.79 for steam.

It is unnecessary to give further explanation concerning the humidity and the dry- and saturated-volume curves. As for the latent-heat curves, data are plotted only in the lower temperature range, because we do not need values above 212 deg. F. so far as drying under atmospheric pressure is concerned.

PLOTTING of the humid-volume lines is a new proposal of this article. In previous charts the humid volumes were found by interpolation between the dry and saturated volumes, which method is not only somewhat tedious but also is applicable only for the lower temperatures. According to definition, however, the humid volume of gas, V_h, at temperature, t deg. F., and humidity, H, may be expressed as follows:

$$V_h = \frac{(359)\ (t + 460)}{492}\ (1 + H)$$

From this equation it is evident that, for a constant value of H, the relation between V_h and t is linear. A series of such lines is plotted for several values of H separated by constant intervals. By the aid of these lines one is able to obtain the volume of humid gas at any temperature and humidity.

It will be noted that, because of the basis chosen, the humidity and the dry, humid, and saturated volumes are all independent of the composition of the gas.

On the other hand, the humid heat and, therefore, the adiabatic cooling lines vary with the CO_2 content of the gas. Humid heat, C_h, is expressed by the following:

$$C_h = 7.01\ (1 - x) + 9.55x + 8.79H$$
$$= 7.01 + 2.54x + 8.79H,$$

where x is the mol-fraction of CO_2 in the dry gas; for air, therefore, x is zero. In the chart three lines of C_h against H are plotted for $x = 0$, 0.1 and 0.2: that is, for air and gases of CO_2 content of 10 and 20 per cent respectively. It is not necessary to plot lines for higher values of x, because the highest possible CO_2 content in dry flue gases, using air for combustion, is 21 per cent.

In the adiabatic cooling process the relation between the temperature, t, and the humidity, H, of the gas at any instant may be expressed by the following equation:

$$[r_w + 8.79\ (t - t_w)]\ dH = (7.01 + 2.54x + 8.79H)dt.$$

Solving this differential equation, substituting the final equilibrium conditions (that is, $t = t_w$ and $H = H_w$), and making the proper transformation, one obtains:

$$r_w\ (H_w - H) = (7.01 + 2.54x + 8.79H)\ (t - t_w)$$

which is the required equation of the adiabatic cooling lines, where t_w, r_w and H_w are the wet-bulb temperature of the gas, the latent heat and the saturated humidity at the wet-bulb temperature, respectively. The cooling lines for various wet-bulb temperatures are calculated by this equation and plotted in such a way that three lines with a common wet-bulb temperature are drawn for air and for gases of 10 and 20 per cent CO_2 content, respectively. The differences between these curves are suffi-

[1] At present engaged in special work in the Department of Chemical Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

[2] *Editor's Note*—Humidity, humid heat, etc., are used here substantially as defined by Grosvenor in the reference noted above. They may also be found in *Chem. & Met.* 35, 224, 1928; and in "Principles of Chemical Engineering," Walker, Lewis and McAdams, p. 436.

ciently small so that accurate interpolation for intermediate values of CO_2 can be made without difficulty.

Thus, the adiabatic cooling lines are drawn on the assumption normally made that the true wet-bulb temperature can be calculated by the heat balance method. At moderate temperatures and humidities this assumption is certainly valid within the precision of all the data available. While it seems certain that the assumption breaks down at high temperatures, it represents the best approximation at present available for those conditions. Granting this assumption, the cooling lines as shown represent quantitatively the path followed in the adiabatic cooling of a gaseous mixture in contact with wet stock at the wet-bulb temperature of the mixture.

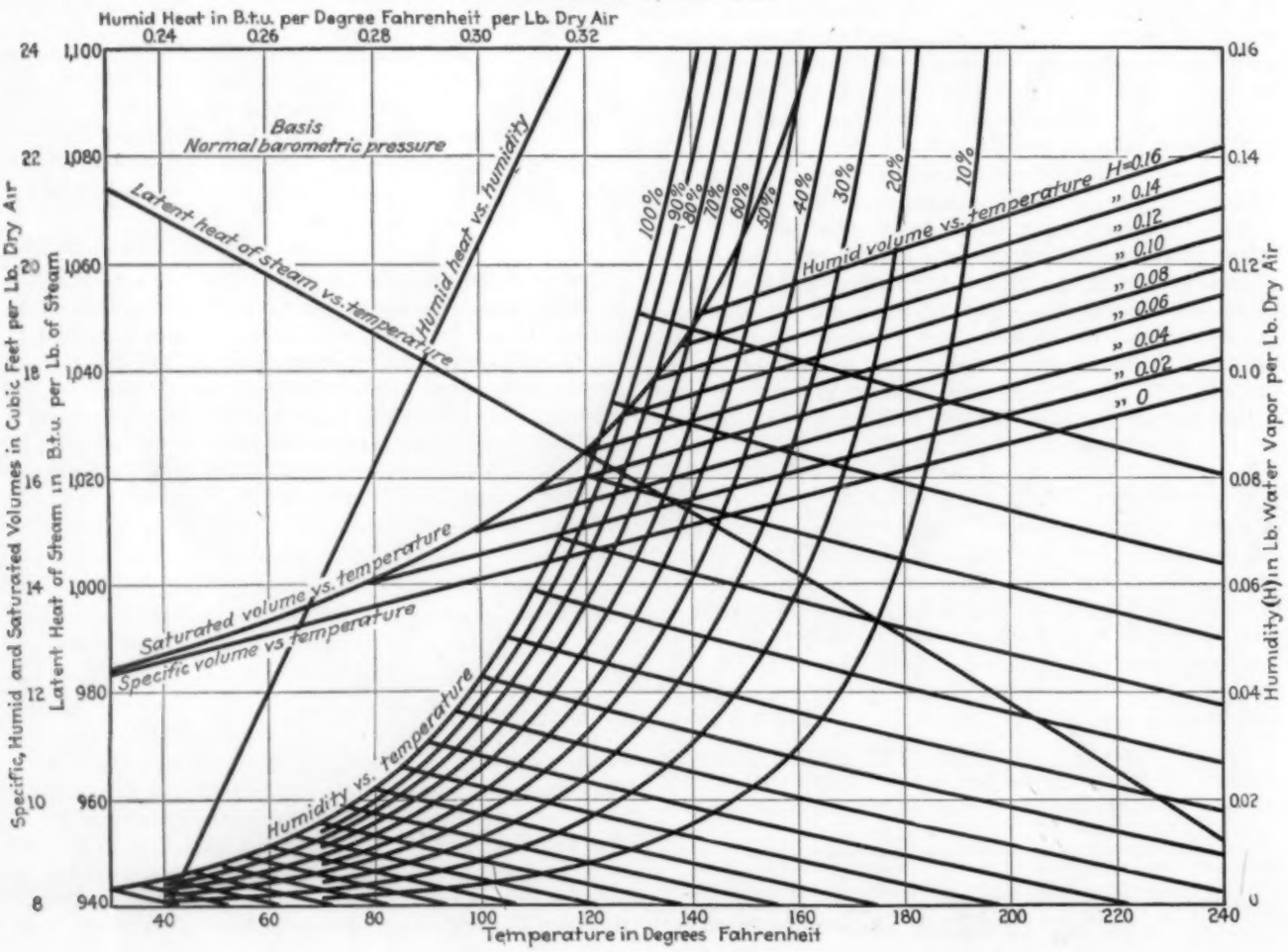
Now it may be noted that, while the volume change accompanying an adiabatic cooling process is not without interest, the cooling lines plotted above are not concerned with the volumes at all. This volume change, however, can be easily traced by the combined use of the adiabatic cooling lines and the humid-volume lines. At first we can find by the cooling lines the relation between the temperature and the humidity at any instant, then we can obtain by the humid-volume lines the volume of the gas corresponding to the known temperature and humidity.

It will now be worth while to examine the use of the chart in a specific case. Consider the case of a waste heat, direct-contact, rotary dryer using stack gases to dry a water-soaked stock. Gases enter the dryer at 480 deg. F. and leave at 160 deg. with a wet-bulb temperature of 135 deg. Carbon dioxide content is 15 per cent. Evaporation per hour is 1,400 lb. of water. It may be assumed that the operation of the dryer is adiabatic and that the stock is at the wet-bulb temperature throughout.

On the chart we follow a cooling line from the 135-deg. wet-bulb point on the saturation line to a dry-bulb of 160 deg., finding the final condition of the gas at a humidity of 0.197 mol of water vapor per pound of dry gas. Passing horizontally to the saturation line, we find a dew point of 132 deg. The initial condition of the gas, due to the adiabatic process followed, lies on the same cooling line as the final condition, at 480 deg. with a humidity of 0.059, corresponding to 15 per cent CO_2 and a dew point of 94 deg. Moisture gained by the gas is hence 0.197 — 0.059 = 0.138 mol per mol of dry gas, and the gas required for the evaporation is $\frac{1,400}{18.02 \times 0.138} = 563$ mols of dry gas per hour. The humid-heat lines show a gas of 0.059 humidity and 15 per cent CO_2 to contain 7.92 B.t.u. per degree F. per pound mol of dry gas. The heat used is therefore 563(7.92)(480 — 160) = 1,433,000 B.t.u. Use of the humid-volume lines shows the entering gas to be 730 cu.ft. and the leaving gas 542 cu.ft. per pound mol. Multiplying these by the mols of dry gas per hour, 563, we find them respectively 411,000 and 305,000 cu.ft.

In Fig. 2 a humidity chart is reproduced for air at temperatures of from 30 to 240 deg. F. It is constructed by the method outlined above, but on the usual basis of 1 pound of dry air, using the most reliable data available at present. It differs from previous charts in that humid-volume lines are given for several values of *H*. It conforms quantitatively with the chart on page 164.

Fig. 2—Revised Psychrometric Chart for Air, 30 to 240 Deg. F., Giving Humid Volume for Various Values of *H* (Basis: Pounds of Water Vapor and Dry Gases)



Calcium Chloride and Flue Gas *Used in Novel Process* For Waste Disposal

Economical method developed for processing alkaline kier liquors from textile plants

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PRELIMINARY to the bleaching of cotton, in whatever form, it is customary to boil the material for several hours in a dilute solution of sodium hydroxide. This operation is generally called "boiling-out" and has for its purpose the removal of the waxy and resinous matters from the cotton fiber. The boiling is carried out by means of live steam in closed vessels, known as "kiers." At the end of the boiling period, the spent alkaline liquor is drawn off at the bottom of the kier, and it is this waste material which is referred to hereinafter as "kier liquor." In appearance it is a very dark, reddish-brown, soapy liquor.

It appears to be common practice in New England textile plants to dispose of this material by running it to waste into streams. Kier liquor, however, is anything but a desirable addition to a stream which otherwise might be comparatively unpolluted. Its free caustic, organic matter and very high oxygen-consuming capacity are deadly to aquatic life; it carries much coloring matter and renders the stream water unfit for subsequent use in textile or paper mills unless the dilution is very high; and it renders the stream water unfit for boiler feed, causing foam, unless again the dilution be very large. The present paper discusses the results of some of the work that has been performed in connection with the problem of kier liquor disposal, and describes a process that promises satisfactory results at a low cost.

Some twenty-odd schemes for disposal of kier liquor have been given consideration so far, and a few have been studied in detail. It was evident at the start that certain general types of processes would result in a cost of treatment so high as to prohibit consideration. Thus the concentration of caustic in the liquor is so low that processes looking toward its recovery did not appear to be feasible. Disposal by evaporation and incineration of the residue also appeared to be too costly, partly because the content of organic material is so low as to furnish by its combustion only a negligible part of the heat required for evaporation. The expense of filtration also is so great as to make it desirable to avoid it.

The general type of process which appeared to promise the most economical treatment consisted of precipitation of the organic compounds, followed by sedimentation of the precipitated material and discharge of the clarified liquor to the stream. As a result of work along this line, a disposal process has been developed which appears to be the most feasible of any yet considered. This process may be briefly described as follows:

On discharge of the kiers, the hot liquor is run to storage tanks. From here it is pumped at a constant rate to the top of an absorption tower. Flue gas from the power plant is sent up through the tower, and, meeting the descending kier liquor, carbonates it more or less completely. It is necessary to absorb at least enough carbon dioxide to convert all the free caustic to carbonate. It is not practicable, however, to attempt control of tower conditions so as to form only carbonate, and no bicarbonate, since the temperature as well as the concentration of both caustic and carbon dioxide will vary. The liquor leaving the bottom of the tower, containing a mixture of both carbonates and bicarbonates, is caught in a tank. There is then added enough of the untreated kier liquor to give a mixture containing only carbonate. To this is next added an amount of calcium chloride somewhat more than chemically equivalent to the total alkalinity of the kier liquor. This final mixture is then run out into a settling basin, where the solids settle and from which the clarified liquor may go to the stream.

This process for the disposal of kier liquor has been studied intensively in the laboratory, and has been tested by the operation of a small experimental plant having a capacity of about 30 gal. per hour. It has been found that the precipitate produced by the treatment settles very rapidly, and after a few hours 93 to 95 per cent of the liquor may readily be drawn off. This clarified effluent possesses a color equal to 20 to 25 per cent of that of the original liquor, and has a pH value of 7.8 to 8.5. The removal of organic matter is in about the same proportion as the reduction of color.

The cost of treatment, including chemicals, power, supervision, repairs and maintenance, interest, taxes, insurance, and depreciation is estimated at $0.80 per thousand gal., for a plant to handle 40,000 gal. of kier liquor per day. This cost would be distributed as follows:

Operating Costs of Proposed Plant

	Per Cent.
Chemicals	72.3
Power and Light	3.5
Supervision	12.6
Repairs and Maintenance	0.8
Interest	4.8
Taxes and Insurance	0.8
Depreciation	5.2
Total	100.0

Presented before the meeting of the American Institute of Chemical Engineers, Asheville, N. C., Dec. 24, 1929, as abstracted from parts of a dissertation by Raymond L. Copson, in candidacy for Ph.D. degree at the Yale University Graduate School.

In working out this method of disposal, a great deal of laboratory work has been done bearing on the nature of kier liquor and on precipitation with various reagents. While it would be impracticable to attempt here a detailed exposition of all that has been done, a few of the observations seem of sufficient interest to warrant discussion.

As a preliminary to the study of kier liquor itself, the authors visited six of the Connecticut plants producing such liquor. One of these plants manufactures chiefly "chemical cotton" from cotton linters, one produces absorbent cotton and gauze for surgical use, and four are engaged in textile finishing. The items of most interest at the time were the quantity and uniformity of kier liquor produced. It was found that plants engaged in similar operations do not use the same strength of caustic in the kiers, the concentration varying from 1.5 to 5.5 per cent of sodium hydroxide. The alkalinity of the waste liquors from the different plants varies accordingly. At the time the plants mentioned above were visited, the kier liquors discharged were found to vary in alkalinity from 0.44 to 1.72 per cent (as NaOH).

It will be noted that the alkalinity of the waste liquors is much less than that of the solution charged into the kiers, probably due to dilution by the water carried on the wet cloth, by condensed steam, and by wash water. These factors are so variable that the alkalinity of the kier liquor from any given plant will also show considerable differences at different times. Thus titrations of the liquor from a certain plant over a period of more than six months showed a variation in the total alkalinity of from 0.330 per cent to 0.617 per cent., with an average value of 0.497 per cent (as NaOH).

Not only is the alkalinity in the liquor reduced by dilution in the kier but a large part of the sodium hydroxide reacts with the organic materials present as impurities in the cotton, without, however, reducing the total alkalinity as indicated by titration to a methyl orange end point. The following analysis of kier-liquor alkalinity is typical:

To phenolphthalein end-point—0.0720 gm. = equiv. per liter.

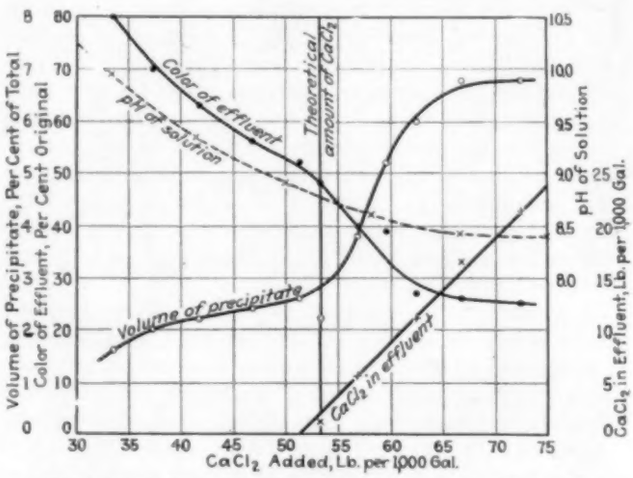
To methyl orange end-point—0.1135 gm. = equiv. per liter.

Since the liquor was shown to carry not more than a trace of carbonates, it might be thought that the titration to a phenolphthalein end point measured the free caustic, NaOH, while titration to the methyl orange end point measured both the free caustic and the sodium combined with weak organic acids. The situation is not quite so simple as this, however, for if an excess of neutral barium chloride solution be added to the kier liquor before titration, the phenolphthalein end point shows an alkalinity due to free caustic of only 0.0422 gm.-equiv. per lit. It is therefore evident that there are sodium organic compounds present which hydrolyze sufficiently to be included in the titration to a phenolphthalein end point, the amount of these being 0.0720-0.0422, or 0.0298 gm.-equiv. per lit. Since the total alkalinity is 0.1135 gm.-equiv. per lit. and the true free caustic is 0.0422 gm.-equiv. per lit., it is evident that the total sodium tied up in titratable organic compounds is that equal to 0.1135-0.0422, or 0.0713 gm.-equiv. per lit., of which 0.0298, or 42 per cent, is hydrolyzed so as to have a pH value greater than that at which phenolphthalein changes color.

The thought suggests itself that the predominating compound in kier liquor may be the sodium salt of one or more dibasic organic acids which, on titration, reaches the pH of phenolphthalein change when one of the two sodiums has been replaced, its behavior in this respect being analogous to that of sodium carbonate. The following picture of the situation might therefore be constructed, the symbol X representing the dibasic organic acid radical:

Compound	*Gram Equivalents Per Liter of Kier Liquor*
Na_2X	0.0713
NaOH	0.0422
Total	0.1135

The nature of the alkaline compounds in kier liquor is important in connection with the treatment with flue gas as described above. It has been shown experimentally that the amount of carbon dioxide that kier liquor will


Volume of Precipitate, Per Cent of Total
Color of Effluent, Per Cent Original
pH of Solution
CaCl2 in Effluent, Lb. per 1000 Gal.
CaCl2 Added, Lb. per 1000 Gal.
Color of effluent
pH of solution
Theoretical amount of CaCl2
Volume of precipitate
CaCl2 in effluent

Data for Optimum Quantity of Calcium Chloride to Be Added for Precipitation

absorb is greater than that which is sufficient to convert all of the free caustic to sodium bicarbonate; the data in fact indicate that the Na_2X compounds which have been assumed to be present absorb carbon dioxide just as sodium carbonate does. This fact has a bearing on the operation of the disposal plant, since, if the kier liquor is treated in the tower with a large excess of carbon dioxide, more than an equal volume of untreated liquor must subsequently be added in order to allow for the carbon dioxide absorbed by the Na_2X compounds.

The addition of calcium chloride to the carbonated liquor not only results in the precipitation of calcium carbonate but also in the formation of insoluble calcium salts corresponding to the sodium organic compounds present in the original liquor. There are also precipitated those organic compounds which are dissolved from the cotton fibers and held in true or colloidal solution by the sodium hydroxide or the still highly alkaline sodium carbonate. This precipitation is so complex that a study was made in some detail in order to determine the conditions necessary to bring about a maximum precipitation and a maximum removal of color.

It was found first of all that variations in the temperature of the kier liquor had practically no effect on the results. Some differences in the initial rates of settling of the precipitates were observed, those formed at the higher temperatures settling somewhat more rapidly.

In order to determine the amount of calcium chloride necessary for optimum precipitation, the data summarized in the accompanying graph were secured.

It is shown there that the optimum quantity of calcium chloride is not that chemically equivalent to the total sodium compounds present. The greatest increase in the volume of the precipitate and decrease in color of the effluent come only after an excess has been added. The data indicate that an excess of about 15 per cent of the theoretical is the optimum amount to use. The excess of calcium chloride, however, is not precipitated, but remains in solution, as shown by the analyses of the effluent liquors.

The process that has been described above offers a means for the disposal of kier liquor at a very moderate cost. The equipment necessary for the disposal plant is of the simplest type, so that the capital investment and fixed charges are at a minimum. The treatment results in the production of an effluent that is practically neutral, and whose color and content of organic matter has been reduced to from 20 to 25 per cent of that of the original.

In this respect the solution of the problem is not ideal, since the color of the effluent is still fairly dark. It has indeed been found possible to reduce the color still further by additional treatment, as, for example, by coagulation with aluminum hydroxide, but this has not seemed to be generally desirable, since the increased cost is too great in comparison to the small improvement realized.

The chief objection to this method for the treatment of kier liquor is that there is left a sludge of precipitated calcium carbonate and organic matter. Storage for this sludge, or other means of disposal, therefore, must be provided. It is possible that it might be found worth while to give this sludge further treatment, in order to recover some part of the organic substances present.

Finally, it should be pointed out that in developing the above kier liquor from a plant producing "chemical cotton" was used. Kier liquor from this source was chosen since in color it was the worst of the waste liquors from any of the six plants visited. The estimate of costs given above was also based on conditions existing at this plant.

New Criterion for COKING VALUE *of* COAL

A study of time-temperature relations in the plastic-range test of a coal yields significant lights on its behavior in the oven

By T. C. LLOYD

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***A true criterion of the coking behavior of coal has long been sought. When first described, the plastic-range test of coal seemed largely to satisfy this need; but very great difficulty and confusion, both in the method of making this test and in its interpretation, have prevailed during the nine years since this test was first proposed in England. The results described by Mr. Lloyd in this paper explain much of this confusion and apparently advance coal-testing methods very far along toward their goal. It is evident that the shape of plastic range curves has much more significance than hitherto realized. All those interested in any phase of coal carbonization which is affected by coal behavior will do well to ponder Mr. Lloyd's interpretation of these curves and will await with interest the further outcome of this work which is being continued at Yale University.*—The Editor.**

STUDY of the plastic range of coal by the gas flow method depends on the increase in resistance of the coal mass to the passage of gas as it liquefies, either wholly or partly, prior to the coking stage. It was first used by Foxwell (*J. Soc. Chem. Ind.*, **40**, 193; 1921), who used this method to study the path of travel of gases in the coke oven. He passed gas through a layer of coal 6.5 cm. long packed in a horizontal tube, keeping the rate of gas flow constant. Pressures up to 479 mm. (18.9 in.) of water were developed. In further work discussed in a series of papers in Vol. 3 of "Fuel," coal was subjected to gas pressures up to 1,000 mm. (39.4 in.) of water. Layng and co-workers (*Ind. Eng. Chem.*, **17**, 165, 1925; and **19**, 924, 1927) use a similar apparatus, developing pressures up to 1,810 mm. (71.3 in.) of water. More recently, Marquard gives curves for the plastic range of coals used at the Clairton Coke Plant (*Blast Furnace and Steel Plant*, **16**, 754, 914, 1928). He uses pressures up to 4.8 in. water.

The desirability of investigating this phase of carbonization came to my notice early in 1928 when in search of a Pocahontas coal of a coking quality comparable with Maitland coal, which is discussed later. The apparatus shown in Fig. 1, which is self-explanatory was set up for the experiment. The gas holder of about 1 cu.ft. capacity gave without weighting a maximum pressure of 2.2 in. water. In preliminary experiments, pressures up to 6 in. of water were de-

veloped by weighting, but these did not give consistent results so that weighting was discontinued, and the maximum pressure used was 2.2 in. water.

Method of Determination

The experiment is carried out as follows: A sample of run of mine coal, or, more commonly, a sample collected after passing the coke plant hammer mill is screened through 10 mesh and the coarse crushed in a roll crusher adjusted to slightly less than $\frac{1}{10}$-in. clearance between the rolls until all passes 10 mesh, when the whole is mixed. (Tyler standard screens are referred to throughout.) In earlier experiments, a silica tube was used, but due to the difficulty of removing hard cokes from a fragile tube, this was discarded and a $\frac{3}{4}$-in. iron pipe screwed into a $\frac{3}{4}$-in. coupling, bushed down to $\frac{1}{2}$-in. and screwed into $\frac{1}{2}$-in. pipe, as indicated in the diagram, was used. The construction formed a useful support for the coal, and the threaded surface of the coupling minimized gas leakage up the wall. A plug of wire gauze is tapped down into the coupling and a thin pad of asbestos fiber placed on this so that when connected up to the rest of the apparatus and gas passed, the manometer indicates a pressure not over 0.1 in. water. The prepared sample is then poured on to the pad and settled evenly by tapping the pipe. When connected up again and gas passed at the rate of 0.035 cu.ft. per minute, the pressure should be within the range 0.7-0.8 in. after the pyrometer has been inserted. (Gas flow is measured by a $\frac{1}{10}$ cu.ft. meter in conjunction with a stop watch.) A 1-in. layer of coal will, in general, satisfy these requirements.

Heating is then started at such a rate that the beginning of the plastic range is reached in one hour and thereafter at 2-deg. F. per minute, time temperature, pressure, and gas flow being recorded every 20-deg. rise. As the softening of the coal becomes more marked, the pressure rises slightly to the maximum of 2.2 in. and thereafter falls off as the coking stage is entered. Some of the curves obtained are shown in Fig. 2, in which gas flow under 1-in. water pressure is plotted against temperature in deg. F.

A word of explanation about the ordinates is desirable. It was found, in general, that at the start of the plastic range, the pressure had risen to 1.5 in. water, and, as stated, did not thereafter rise above 2.2 in. It seems not unreasonable that, throughout this slight change in pressure, gas flow will be proportional to pressure. Thus, by dividing actual gas flow by actual pressure, the gas flow under 1-in. water pressure is obtained. This figure is used for ordinates. It is realized that this reasoning may be open to objection, but it is probable that the error so introduced is less significant than the errors of method.

It appears certain that in all cases where an attempt is made to keep a uniform rate of flow of gas during the plastic state, pressures are built up to what corresponds to a yield point of the fused mass which is so distended that its porosity is increased.

Maximum Plasticity Range

Previous workers have all found a sharp maximum, where pressures were plotted against temperature, indicating that the condition of maximum fluidity is a mere point function of the temperature. It is the purpose of this paper to show, however, that the maximum plasticity extends over a range of temperature and that the duration of this maximum would appear to be one of the most important, if not the most important, of the factors which determine the coking quality of a coal.

This fact seems to be confirmed by the essentially different curves obtained for high-volatile and for Pocahontas coals, a fact which seems to have escaped the notice of previous workers. It is found that high-volatile coals give with this apparatus a curve which is roughly symmetrical about its minimum, the slope towards the minimum being similar to the slope away from it. This seems to be an experimental fact without theoretical support.

For Pocahontas coals, on the other hand, the curves are by no means symmetrical, the slope away from the minimum being very gradual compared with the sharp slope approaching it, this slope away from the minimum being, as is explained later, an index of coking quality. The coals discussed are the following:

Mine	County	State	Characteristics
Royal	Fayette	Pennsylvania	High volatile
Isobella Klondike	Fayette	Pennsylvania	High volatile
Black Mountain	Harlan	Kentucky	High volatile
Elkhorn	Letcher	Kentucky	High volatile
Mather	Greene	Pennsylvania	High volatile
Maitland	McDowell	West Virginia	Pocahontas
Crane Creek	Mercer	West Virginia	Pocahontas
Pond Creek	McDowell	West Virginia	Pocahontas
Empire	McDowell	West Virginia	Pocahontas
Carswell	McDowell	West Virginia	Pocahontas

In Fig. 2 (*a*) the result of weathering Royal coal is shown. The destruction of the plastic range is accompanied by deterioration in coking quality as found in practice. This is essentially as found by Layng and Coffman (*loc. cit.*). Curves for a number of high volatile coals are shown in Fig. 2 (*b*). Mather appeared to be the best coking coal of these, comparing well with Royal, which was a good grade coking coal. Isobella Klondike and Black Mountain were stated to be poorer quality coking coals, and the shrinkage of the plastic range conforms with this observation.

In Fig. 2 (*c*) may be seen the results of tests on a sample of Carswell Pocahontas coal after passing the

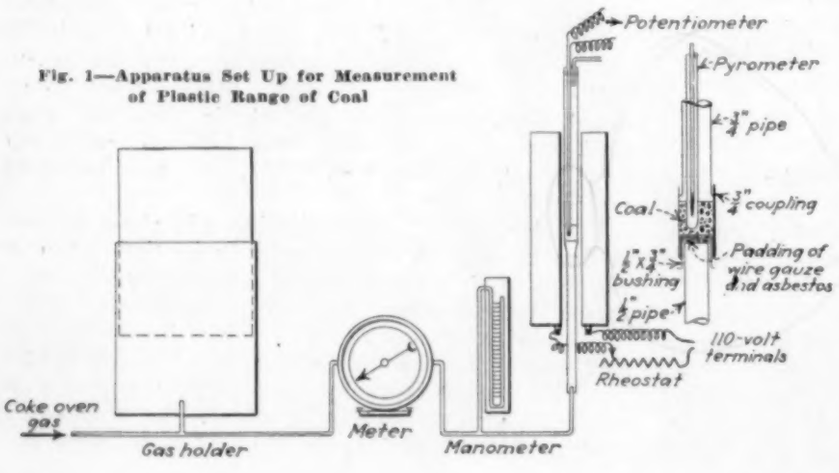

Fig. 1—Apparatus Set Up for Measurement of Plastic Range of Coal

hammer mill. The fractions from the Tyler Rotap machine were taken and the coarser fractions crushed before using. The curves for the separate fractions may be compared with that from the unscreened coal which is shown in Fig. 2 (*d*). The coking qualities of the coarser fractions were studied by screening a large amount of the coal, crushing the coarser fractions, and mixing the sample so obtained in the proportion of 15 to 85 per cent of Royal high-volatile coal. The mixture was placed in a carbide can and lowered into the empty coke side of the empty coke oven before charging. After pushing and quenching, the sample was collected from the coke wharf and subjected to a tumbler test to determine friability. The coke from samples of coarser mesh coal gave the poorest samples of coke, thus further confirming the relation of plastic range to coking quality. It may be noted that the proximate analysis of these coal fractions showed but little variation. As a result of this investigation, more careful screening of the coal at the mine was insisted on with gratifying results. The curves show also the mistake of discarding any screened fraction of a coal in preparing an average sample for experiment, as has been done by some workers.

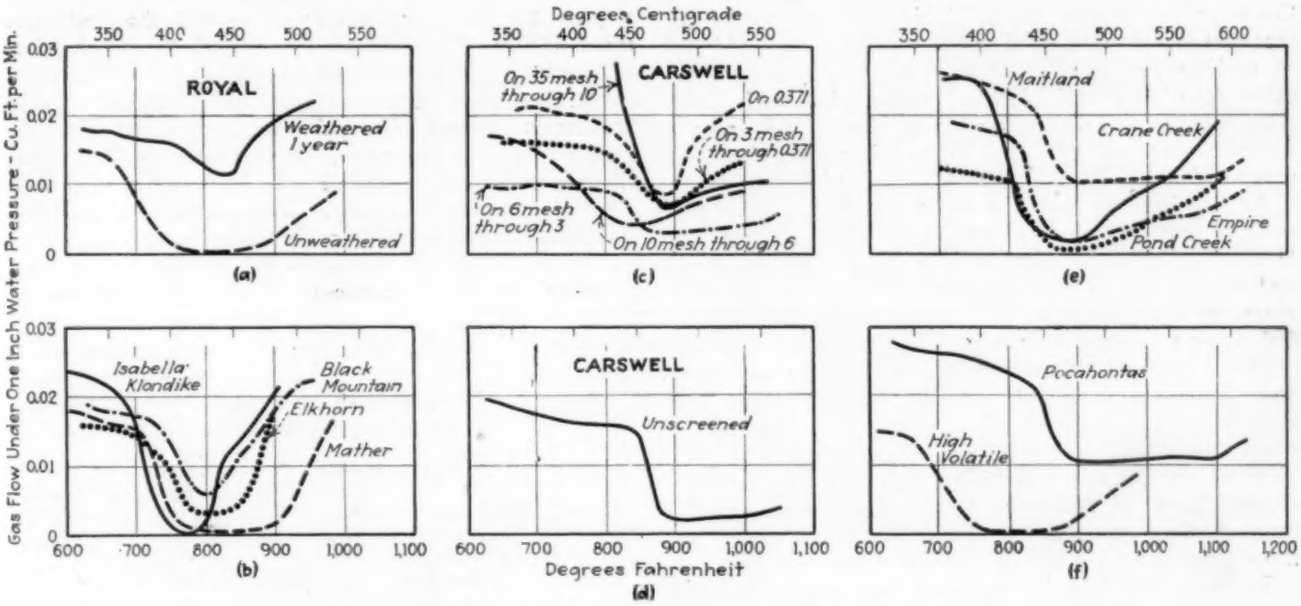

Fig. 2—Measurements for Plastic Range of Various Kinds of Coal

Insight Into Coking Process

In Fig. 2 (*e*) are shown curves obtained from four Pocahontas coals. Compared by coking tests, Maitland was found to be the best of these; Pond Creek and Empire were of lower grade; while Crane Creek was distinctly poor. From these and other coals investigated which have been found to obey the same rule, it seems to be fairly well established that the slope of the curve in the range 900-1,100 deg. F. is a reliable index of the coking quality of the coal. The greater the slope, the poorer is the coke. This is in agreement with the results for high volatile coals and also with speculative reasoning on the nature of the coking process. It is reasonable to suppose that any coal which remains liquid or semi-liquid for a relatively long period so that time is allowed for the particles to flow together and form a homogeneous whole will give a better coke than a coal in which the plastic range is restricted to narrow limits and hardening commences before any degree of homogeneity has been obtained.

To aid in visualizing the process of coke formation from a coal mixture, such as is commonly used in the coke oven industry, curves for a high grade volatile coal and for the best grade of Pocahontas coal have been plotted together in Fig. 2 (*f*). It will be noted that the high volatile coal enters the plastic stage some 150 deg. below the Pocahontas and is already nearing the coking stage when the Pocahontas coal becomes liquid. This is advantageous inasmuch as better mixing is effected by having only one of the component coals at a time in the liquid state, since the fluid is free to flow around the solid particles of the other component, whereas two thick semi-liquid masses would probably intermingle more slowly, due to their mutual viscosity and resistance.

Experimental Conclusions

The investigation may be summarized as follows: An apparatus is described in which the plastic range of coal may be satisfactorily studied by passing gas through it under a maximum pressure of 2.2 in. water. Exception is taken to the high pressures used by previous workers. With this apparatus the plot of gas flow against temperature time is roughly symmetrical for high volatile coals, and the state of maximum fusion persists over at least a 100 deg. F. rise in temperature for a good quality coking coal. For Pocahontas coals, the plot is not symmetrical, but slopes gradually toward the coking temperature. The slope of this curve in the range 900-1,100 deg. F. is a reliable index of coking quality. This portion of the curve is very nearly horizontal for the highest grade low volatile coking coals and increasing slope is an indication of diminishing coking power.

Thanks are finally due to J. W. Hacker for many helpful suggestions and to the Central Alloy Steel Corporation for permission to publish this work.

READERS' VIEWS AND COMMENTS

An Open Forum

The editors invite discussion of articles and editorials or other topics of interest

Paper-Making for Southern States

To the Editor of Chem. & Met.:

Sir:—I note with interest the editorial in your issue of November under the caption, "A New Paper-Making Opportunity for the South." This leads me to believe that you will be interested in the writing paper made by us as long ago as 1915 from a furnish containing no other fiber than half bleached yellow pine kraft pulp. Also book paper was made by us about 1918 from a furnish composed of equal parts of yellow pine and gumwood pulps, both produced by the sulphate process.

As also bearing upon the subject matter of your editorial I may say that as early as 1886 I operated, at Newberne, N. C., a sulphite mill using both gumwood and cypress as its raw material. Within the last few years we have developed and demonstrated on commercial scale a process for the production of an excellent grade of newsprint from mechanical ground wood made from Southern gumwood and half bleached yellow pine kraft pulp, and a patent of ours, of 1927, illustrates a novel use of colloidal cellulose in this connection. In view of the present widespread agitation over the increased price of newsprint this process is of especial interest, since gumwood is obtainable in quantity at no more than one-third the price of Northern spruce.

However this may be, one may rest assured that we are only at the beginning of a great paper-making development in the South. ARTHUR D. LITTLE.

President,
Arthur D. Little, Inc.,
Cambridge, Mass.

Editor's Note:—It is a pleasure to present Dr. Little's remarks on the subject at this time, because of both his fundamental work on this phase of paper-making and his very early appreciation of what the South offered to industrial chemical enterprise.

* * * *

Defining duPont's Fertilizer Interests

In discussing the fertilizer industry on page 44 of its January issue, *Chem. & Met.* commented on what was characterized as the "decision of the duPont organization definitely to enter the fertilizer business." While it is true that the Du Pont Ammonia Corporation through the sale of ammonia to the superphosphate manufacturers has become an important factor in the fertilizer industry, it has been as a supplier of raw material and not as a producer of complete fertilizer. The duPont organization has made no definite announcement of its intention to enter the latter phase of the fertilizer business, which may have been implied by the statement quoted above.

Sulphuric Acid Industry's Changing Complexion

After publication of the January issue, carrying a list of domestic sulphuric acid plants on pages 51-52, *Chem. & Met.* was pleased to receive answers to its request for necessary modifications and changes from the following: O. K. DORBRANDT, Little Rock Chamber of Commerce; J. L. GOOD, Eagle-Picher Lead Company; T. R. HARNEY, Monsanto Chemical Company; J. A. HICKMAN, United Chemical Company; PARK KELLEY, Ozark Chemical Company, W. C. KOESTER, Louisiana Chemical Company; and E. J. SAWBRIDGE, National Zinc Separating Company. The results of their information are combined in the table below:

State	Company	Change
Arkansas	Arkansas Fertilizer Co.	Makes no acid
	Commercial Acid Co.	Now Southern Acid & Sulphur Co.
	Ellory M. Davis Corp.	Out of business
	Southern Acid & Sulphur Co.	No. Little Rock
Colorado	Western Chemical Co.	Owned by General Chemical Company
Illinois	American Smelting & Refining Co.	No plant
	Anaconda Copper Mining Co.	No plant
	Commercial Acid Co.	Taken over by Monsanto
	Lanyon Zinc & Acid Co.	Taken over by Eagle-Picher
	Victor Chemical Co.	Burned down
	Eagle-Picher Lead Co.	Contact plant operating since 1924
Indiana	Rauh & Sons Fertilizer Co.	Dismantled
Kansas	National Zinc Company	Dismantled
Louisiana	Stauffer Chemical Co.	No plant
	Texas Chemical Company	No plant
New Jersey	American Smelting & Refining Co.	Dismantled
	King Chemical Co.	Taken over by Calco
New York	Kalbfleisch Corp.	Dismantled
Oklahoma	Mid-Continental Chemical Co.	Out of business
	Ozark Chemical Co.	Located at West Tulsa
Pennsylvania	American Alkali & Acid Co.	Dismantled
Tennessee	Kalbfleisch Corp.	No H_2SO_4 plant
Texas	Sugarland Mfg. Co.	Dismantled
	Ft. Worth plant of United Chemical Company	No plant
Utah	Garfield Chemical Co.	Dismantled
Wisconsin	New Jersey Zinc Company	Dismantled

CHEMICAL ENGINEER'S BOOKSHELF

Industrial Gas Determination

GAS ANALYSIS. By *L. M. Dennis* and *M. L. Nichols.* 2nd Edition. The MacMillan Company, New York, 1929. 500 pages. Price, $4.

Reviewed by W. O. HEBLER

GASES are encountered in practically every chemical process known. The main object in most cases is "maximum efficiency with minimum maintenance cost." Bearing this in mind, it becomes obvious that those interested in the maintenance of the plant and its apparatus must have a thorough knowledge of the gaseous mixtures which are prevalent in the various systems. We know how important it is to detect flammable mixtures of gases in oil tanker holds; the control of solvent vapors in film and cellulose manufacture in order to reduce explosion hazards; the determination of hydrogen in chlorine to prevent explosion; to analyze for CO in mixtures of gases as applied to converters to prevent poisoning of catalysts; measurement of CO_2 to determine efficiency of combustion in boilers; measurement of SO_2 in sulphite pulp manufacture to guard against sublimation of sulphur on tubes, etc.

Each day we find that a certain gas in a mixture of gases is perhaps an offender which may cause serious damage to the equipment or may interfere with the uniformity of product. It is essential, therefore, that ready reference for the determination or detection of these gases be had. "Gas Analysis" illustrates in a very simple, straightforward manner how to go after your own particular problem without delving into many voluminous reference books. It is, in the reviewer's estimation, the outstanding book on gas analysis.

Professor Dennis has not taken up the subject of thermal conductivity gas analysis in sufficient detail to give the reader full knowledge of this subject. This is due perhaps to the fact that this method of analysis is still comparatively new and the only work available at the time was that of Weaver and Palmer, of the Bureau of Standards. No doubt in some of his future work he will take up the details concerning this procedure, as it provides those interested in the maintenance of a plant with a complete picture of the general tendencies of the process 24 hours a day.

* * * *

Handbook of Leather Chemistry

THE CHEMISTRY OF LEATHER MANUFACTURE: Vol. II: 2d Edition. By *John Arthur Wilson.* The Chemical Catalog Company, New York, 1929. 683 pages. Price, $10.

Reviewed by THOMAS BLACKADDER

ISSUANCE of a second edition of this work is, needless to say, not due to the rapid advance of chemistry in the leather industry. When the first edition appeared, several years ago, the usefulness of such a book became so apparent that the author has profited by experience and rewritten his book, with the result that many of the objections of the first edition have been met, and the second edition in two volumes, instead of one and of three times the size, is many times as useful.

Up to the time this work appeared, books on leather chemistry were written from the point of view of the tanner, with chemical explanations inserted. Dr. Wilson has written from the view point of the chemist, with illustrations from practice. As a result this work is to be recommended to the chemist irrespective of his special line of interest, who desires to widen his vision by studying what chemistry has been able to accomplish or explain in the tanning industry.

However, one word of warning must be spoken. Production of leather has been a craft for centuries and is not to be reduced to a science in the space of several decades. For this reason, those well versed in leather production may be disappointed with Dr. Wilson's treatment of the subject. To those the reviewer would say that this straightforward exposition of the chemist's point of view offers many avenues of constructive thought and is well worth reading seriously.

Chemists in the tanning industry have in great measure been considered as skilled labor, performing certain operations reducible to the form of a report; usually a tabulation of analyses. The chemistry involved has been mostly empirical. The chemists have not raised themselves above this position as much as they should, partly because of the complexity of the science underlying the manifold operations involved in making leather. Dr. Wilson has collected in his work the latest scientific data on all of these operations, giving the chemist who is engaged in any measure connected with tanning, an oversight of the whole terrain which he could not obtain otherwise without inordinate effort.

* * * *

Rayon's Spokesman

THE RAYON INDUSTRY. By *Moïs H. Avram.* 2nd Edition. D. Van Nostrand Company, New York, 1929. 893 pages. Price, $12.

Reviewed by THEODORE R. OLIVE

BY NATURE optimistic, this reviewer welcomes the advent of each new book on rayon with the feeling that here at last must be the one he has been waiting for. But many disappointments have taken some of the edge from his optimism, and it was with distinct relief that he saw a second edition of Mr. Avram's excellent volume come to his desk. Second editions have a habit of improving on firsts, and this one turns out to be no exception. For the first time the reviewer feels that little has been left for the reader's overworked imagination. What little is wanting is simply not to be had with the industry guarding much of its work so jealously.

The intention of the first edition, published in 1927, was to supply information on all phases of the industry —technical, economic, productive, and financial. The second carries this intention much further—in fact more than 40 per cent further on a page basis. Much of the old material is retained, but the more important chapters and those dealing with the more mobile phases of the subject have been completely rebuilt, while chapters on recovery of chemicals and solvents, and products other than rayon made from cellulose, have been intro-

duced for the first time. Notably strengthened are the chapters on the financial situation of the industry, trade economics, engineering, and the viscose process.

The weakness of the book, if it be a real weakness, lies in the *modus operandi* in American plants. This, of course is inevitable, and, except for the man who is looking for confirmation of his guesses on intimate operating details, should prove no disadvantage. For the technologist who wants the fundamentals, the banker who wants a picture of the whole situation, the market researcher, the textile manufacturer or even the chemical dilettante, the present volume will be found to be an ornamental and highly useful surprise.

* * * *

Chemistry via the Microscope

HANDBOOK OF CHEMICAL MICROSCOPY. *By Emile Monnin Chamot and Clyde Walter Mason.* John Wiley & Sons Company, New York, 1930. 474 pages. Price, $4.50.

Reviewed by JOHANNES KAULKE

IN RECENT years many books on microscopes and microscopy have been published, so Chamot's work challenges comparison. And it proves to be an advance: it is thorough in text and illustrations and covers the optical and mechanical features of a microscope just as well as its manifold applications to chemistry. The title of the book, on the other hand, might just as well have been "Micro" or "Microscopical Chemistry".

Although practically all chemical laboratories are equipped with at least one microscope, it is not applied often enough. Either the worker is not acquainted with the optical properties of the microscope or its application remains a mystery to him. After reading Chamot's book he will undoubtedly bring it from seclusion to light and practice again. In painting a picture of the importance of this "tool" to chemistry, the author really offers in printed form a course in chemical microscopy such as some Western schools have recently announced. He knows his instrument well enough to have made many improvements, and his perfected type is known as the "Chamot Chemical Microscope."

If Mr. Chamot is welcoming suggestions for his second volume, now in preparation, a presentation of the refractometer, spectroscope and colorimeter introduced in like manner to the microscope in his first volume would bring him many more interested readers.

* * * *

The Fundamentals Again

GENERAL COLLEGE CHEMISTRY. By *Joseph A. Babor.* Thomas Y. Crowell Company, New York, 1929. 585 pages. Price, $3.75.

LABORATORY MANUAL IN GENERAL COLLEGE CHEMISTRY. By *Joseph A. Babor* and *Alexander Lehrman.* Thomas Y. Crowell Company, New York, 1929. 376 pages. Price, $2.

Reviewed by L. J. DESHA

THIS TEXT and its co-ordinated laboratory manual are designed to provide a year's work for students who have completed a preparatory course. As in many other modern texts, atomic structure is introduced at an early stage; but few other authors, if any, have lived up so consistently to the promise to make this a consistently used tool throughout the entire work.

The reviewer would warmly welcome an opportunity to use these books with a group of twenty serious students of good general ability, an adequate preliminary course, some conception of physics, and that knowledge of arithmetic which is currently assumed but rarely found. Such students are entitled to a course of this sort and would carry away an understanding of and respect for the scientific method. What the results would be with the common, garden-variety of freshman is open to greater question.

EXPERIMENTS IN GENERAL CHEMISTRY. By *H. W. Stone* and *M. S. Dunn.* McGraw-Hill Book Company, New York, 1929. 107 pages. Price, $1.

TO REPLACE a multiplicity of test-tube experiments grouped around particular *elements* by unified assignments designed to illustrate specific *principles,* has been the effort of these authors. Hence arise such divisional headings as Weight Relations, Volume Relations, Solutions, and so forth. The material is well chosen for the purpose in mind, inorganic preparations and simple quantitative work being emphasized. The result is a gradual shift of the introductory course in college chemistry toward an elementary course in physical chemistry, with inorganic substances as illustrative material. The present manual is a frank and consistent adoption of the same policy for laboratory instruction; as such it should be welcomed.

* * * *

Two Books on Electroplating

PRINCIPLES OF ELECTROPLATING AND ELECTROFORMING. By *William Blum* and *George B. Hogaboom.* McGraw-Hill Book Company, New York, 1930. 424 pages. Price, $4.50.

Reviewed by C. L. MANTELL

ELECTRODEPOSITION industries will welcome the appearance of the second edition of this well-known volume. In general, its layout follows the lines of the first edition, with important changes, however, in the inclusion of a new chapter on chromium plating and a revision of the other chapters to bring the subject matter up to date. After a thorough treatment of the leading principles and governing factors, there is a section on the all-important phase of preparation for electroplating. The reviewer regrets that the authors did not devote some space to the engineering side of this phase, particularly the mechanical equipment which has been developed in recent years for the quantity pickling and cleaning of materials in plating. It is further somewhat surprising to see how little use platers in general have made of the large amount of information available on materials of construction for corrosion resistance.

Deposition of the various metals and alloys is the subject matter of the remainder of the book, with the methods of analyses for control of the plating baths included. The emphasis throughout this section is on the chemical side, with very little attention to the mechanical equipment for continuous plating; and yet our plating industries have advanced perhaps more rapidly through equipment of this type, particularly in the automotive industries, than through any other means.

The book's avowed purpose, as stated in the preface, was to bring about a more effective correlation of the principles and practice of electroplating, so that a more general understanding might aid in the continuation and extension of the progress brought about by the co-operation of platers who have come to a fuller realization of

the value and importance of chemistry, chemists employed in the study and standardization of plating processes, manufacturers of plating materials and supplies who are engaged in researches to improve their products, and the industries using plating who are demanding higher qualities of products. In this work the authors have succeeded admirably.

ELECTROPLATING WITH CHROMIUM, COPPER, AND NICKEL. By *Benjamin Freeman* and *Frederick G. Hoppe*. Prentice-Hall, Inc., New York, 1930. 212 pages. Price, $5.

THIS VOLUME is an attempt to supply the insistent demand which has arisen for information regarding the process of chromium plating. The first three chapters concern themselves with the discussion of elementary electricity and chemistry. Chapter 4 discusses the plating department in a very practical way, while 5 and 6 concern themselves with polishing compounds and cleaning of surfaces. The remainder of the book deals with the deposition of Cu, Ni, and Cr, 52 pages being devoted to the latter subject. The emphasis is on the practical side. There is a question in the reviewer's mind as to whether the discussion in many places is not too elementary. The last sections of the book deal with testing deposits in solutions.

The type in the book is large and the illustrations appear to occupy too much space for the use made of them. In view of the price set for the volume, the total amount of matter contained is somewhat disappointing.

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Bituminous Substances

BITUMINOUS MATERIALS, ASPHALT AND ALLIED SUBSTANCES. By *Herbert Abrahams*. D. Van Nostrand Co., Inc., New York, 1929. 891 pages. Price, $10.

THIS is the third edition of an extremely useful reference book which no one interested in any type of asphaltic material can afford to be without. The amount of bituminous materials used is increasing each year along with the general increase in volume of manufactured goods. In the 10-year period that has elapsed since the author prepared the second edition of his treatise, research has been responsible for new uses for asphaltic materials, and much has been done to perfect the methods of testing these substances.

Expansion of the material in each chapter has resulted in an increase over the second edition of approximately 300 pages. Much of this increase has been due to the work of bituminous dispersions, in which there has been much interest in recent years. Other improvements in the book include the use of larger size type and a flexible cover.

* * * *

An Album of Metallography

ATLAS METALLOGRAPHICUS. Vols. 3, 4, 5, 6 and 7. By *H. Hanemann* and *A. Schrader*. Gebrüder Bornträger, Berlin, 1929. Plates No. 17 to 56 + text. Price, 7.60, 6.75, 6.75, 7.00, and 7.00 M. each respectively.

Reviewed by PAUL D. MERICA

NEW VOLUMES of this unique and important work have appeared, following closely in plan and format the initial volumes published in 1927. These are but the start of an ambitious program to provide a pictorial record of the microscopic structure of steels, the non-ferrous metals and their alloys. The first two volumes dealt with the structure of pure iron and of forged, annealed carbon steels; the present volumes, comprising 23 plates, are almost entirely devoted to a detailed exposition of the structural features of carbon steels in the cast, unannealed state, and to the effect which various thermal and mechanical factors in the prehistory have upon the final micro-structure.

The plates are admirably executed on durable stock and achieve a high order of excellence in the faithful reproduction of details, a matter in which the American technical press is somewhat hesitant. Interleaved with and facing the plates are explanatory tables giving a detailed analysis of each illustration, and the whole collection is strung together on a meager thread of text, which suffices, however, to preserve continuity. It is clearly a work which should grace the shelves of the well-equipped metallographic library, where it will excite the metallographist scanning its pages with the conflicting emotions of admiration and despair.

A slight criticism might be made of the mechanical arrangements. Published with both plates and printed matter in loose sheets, those desiring to preserve them by binding will be disappointed to find the narrow margins of the plates and the stiff paper upon which they are printed a troublesome combination.

* * * *

Recently Arrived

EISENHÜTTE: Taschenbuch fur Eisenhüttenleute. Fourth Edition. Wilhelm Ernst & Sohn, Berlin, 1929. 968 pages. Price, 35 M. cloth, 38 M. leather.—Like all the compendious volumes of this series, the present one is of incalculable value to German-reading engineers; its subject-matter, ferrous metallurgy, is somewhat remote from strict chemical engineering, however.

KORROSION UND METALLSCHUTZ. Supplement from papers read before the Jahresversammlung für Metallschutz at Vienna, 1929. Verlag Chemie, Berlin, 1929. 75 pages. Price, 6 M.—A symposium dealing with very much the same problems that corrosion has raised here: e.g. coatings, wood impregnation, and metals research.

SOCIETY OF CHEMICAL INDUSTRY: Proceedings of Chemical Engineering Group, Vol. X, 1928. Published by the Society, London, 1929. 132 pages. Price 10s. 6d.—Comprehensive papers on such subjects as viscose, air-lifts, glycerine, soap, ultra-violet radiation.

MINERAL INDUSTRY OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES: Statistical Summary, 1926-1928, and Abrasives. Published at His Majesty's Stationery Office, London, 1929. 365 and 67 pages. Price: 7s. 6d., and 2s. 6d.—The former booklet is a valuable correlation of available statistics from mineral and related industries of all countries; the latter is a more detailed study of abrasives.

AMERICAN SOCIETY FOR TESTING MATERIALS: Proceedings of 32nd Annual Meeting, Atlantic City, June, 1929. Part I: Committee Reports, New and Revised Tentative Standards; Part II: Technical Papers. Published by the Society, Philadelphia. 921 and 1,016 pages. Price (each part): paper, $6; cloth, $6.50; half-leather, $8.

INSTITUTION OF CHEMICAL ENGINEERS. Transactions, Vol. 6, 1928. Published by the Institution, London, 1929. 202 pages.—Contains, besides transactions and an account of the American visit, a highly professional set of chemical engineering papers on a wide range of subjects.

GMELINS HANDBUCH DER ANORGANISCHEN CHEMIE. Eisen: Teil A, 2 and B, 1. Verlag Chemie, G.m.b.H., Berlin, 1929. 87 and 312 pages. Price: 13.50 M. and 46 M.—A continuation of the new section on Iron, covering the subjects of "Pure Iron" and "Combinations of Iron."

Selections from Recent Literature

❖

ALUMINA FROM BAUXITE. J. Seailles. *Comptes rendus de l'Academie des Sciences,* Dec. 30, 1929; pp. 1276-9. Calcium aluminate and alumina can be made from bauxite by sintering with lime to form a clinker of the composition $CaO \cdot Al_2O_3$; but the costs for the furnace treatment and for grinding the very hard clinker are too high for commercial production. It has now been found that the reaction can be made to proceed at autoclave temperatures. Lime is added to the bauxite in the proportion $4CaO \cdot Al_2O_3$ or less (down to $2CaO \cdot Al_2O_3$), and the mixture is heated with water in an autoclave for 1½ to 8 hours under a pressure of about 2 to 4 atmospheres. The product is decomposed with sodium carbonate, the sodium aluminate solution is filtered, and alumina is precipitated by a current of carbon dioxide. Yields of more than 90 per cent were obtained in this way in the laboratory; and semi-commercial scale experiments gave yields of the same order. The alumina thus produced is entirely free from iron. This is an advantage over the Bayer process, which leaves some iron in the alumina, because small quantities of iron greatly lessen the corrosion resistance of metallic aluminum. The silica content of the new process alumina ranges from 0.45 to 3 per cent from bauxites containing about 4 to 10 per cent silica. Such silica as remains in the alumina is in the form of calcium silicate, whereas in the Bayer process it is in the form of sodium silico-aluminate. This represents a yield loss, in Bayer process alumina, which is quite serious in the case of highly siliceous bauxites. By utilizing the carbonation method of precipitation, the new process avoids dilutions and the expensive evaporations which would then be necessary.

UNUSUAL CORROSION. F. Wilborn. *Farben-Zeitung,* Feb. 8; p. 945. A previous case of corrosion in which iron was dissolved from a varnished surface and oxidized in the varnish film is now paralleled by experiments with pyroxylin lacquers, in which it was observed that iron hydroxide was formed in the lacquer film. This observation led to immersion tests with an oil varnish. The tests showed bubbles after 54 days in water; in 74 days these had reached a size of about 1 mm. It was expected that removal of the coating from the surface by this blistering effect would be followed by rapid rusting; but after 124 days the test panels still had more than 95 per cent of rust-free area. Microscopic examination of broken blisters from the varnish film revealed black oxide of iron on their inner surfaces. These cases of corrosion of a protected surface are presented without comment as to cause or prevention.

DRIERS FOR RUBBER. B. Lagrange. *Caoutchouc et Gutta-Percha,* February; pp. 14885-7. A system of continuous drying has been developed for application to sheet rubber, either raw rubber of reclaim. Vacuum dryers save steam, but require considerable labor and necessitate batch drying. The movable screen dryers are more nearly continuous, but also require considerable manual attention. The new system was developed for drying reclaim, in loose or sheet form, and utilizes an endless conveyor. Thus the dryer is entirely continuous in operation. The apparatus is known as the Schilde-Comessa dryer. Its cost is comparatively high, but it effects operating economies which enable the added capital charge to be written off very quickly. For drying raw rubber in sheets, a special tunnel dryer construction has been developed. It can also be used for sheeted reclaim. For loose reclaim, the construction is somewhat different. Photographs are shown of both constructions. In the tunnel dryer, provision may be made for vacuum if desired; this improves the thermal efficiency of the operation. Savings in materials, labor, heat, and power are cited.

GAS-REACTION TEMPERATURE. Otto Roelen. *Brennstoff-Chemie,* Feb. 15; pp. 68-70. Gas reactions tend to be quite sensitive to temperature changes; if too cool, the rate of reaction and hence the yield will be too small, and if too hot, the desired reaction is complicated by side reactions. The Fischer-Tropsch process for making gasoline by hydrogenation of carbon monoxide is among the most sensitive of industrial gas reactions; changes as small as 5 deg. C. either way may cause considerable yield losses. It is essential to operate at a temperature below that at which methane is formed, but this necessitates working at a temperature of relatively low reaction rate, so that any drop in temperature seriously affects the yield. The difficulty is increased by the large amount of heat evolved, which is sufficient to raise the temperature, if uncontrolled, to 1,500 deg. C. above the optimum. The difficulty of controlling this reaction probably explains why methane formation from carbon monoxide was known long before it was found possible to synthesize the higher hydrocarbons from the same materials. Methods are discussed for conducting away the surplus heat of exothermic gas reactions, use of water under pressure being noted as having several advantages. It is reported that a successful system has been developed for disposing of the excess heat in the synthetic gasoline process, permitting the use of a specially designed regulator for temperature control of the gases and the contact catalyst mass within the prescribed narrow range of optimum temperature.

DIRECT CHROMIUM PLATING. *Metal Industry* (London), Feb. 7, pp 175-7; also in *Industrial Chemist,* February, pp. 63-5. The Nast process of direct chromium plating, avoiding the usual preliminary step of plating with an undercoat of nickel or the like, is now being worked on a commercial scale in Great Britain. Adhesion of chromium to the base metal is reported to be better than the adhesion of nickel; and the chromium coating can be applied in about 10 minutes, whereas nickel plating requires 40 minutes. Hence the direct method effects a large saving in operating costs and in plating equipment. The Nast process plates as well on steel as on brass, copper, and other alloys; but, since all chromium plating is porous, rustless steel must be used for direct plating. An elaborate process has been developed for applying the new method to aluminum, and it is also being successfully used on various alloys, especially those commonly used for automotive construction. For some articles hardness is required in the chromium coating. This can be regulated, within a certain hardness range, according to the current density; and the hardness can be increased by burning on the coating. The maximum obtainable hardness is about 95 per cent of that of the diamond; but this is too hard for practical purposes, on account of the difficulty of polishing such a hard surface. In connection with the Nast process an electrically heated thermal storage system has been developed, utilizing a tank of 5,650 gal. capacity. This system has automatic control and has greatly benefited the operating conditions of the chromium plating department.

INDUSTRIAL FURNACES. John Fallon. *Metal Industry* (London), Feb. 7, pp. 165-7; Feb. 14, pp. 189-92. Principles of furnace design and operation are discussed in the light of the major functions of industrial furnaces. These are to gasify fuel, convert latent heat energy into utilizable form, distribute heat to materials under treatment, control the furnace atmosphere (reducing, inert or oxidizing) as required, and recover waste heat. Fuels are rated according to thermal yield per unit cost; rating coal at 100, the yields are: coke, 68; fuel oil, 36.4; city gas, 13; electricity, 2.82 to 5.64, at prevailing British prices. Other factors are then discussed; e. g., operating costs and convenience, and quality of output, which may outweigh fuel cost in selecting the fuel for a given purpose. Descriptions, drawings, and fuel cost analyses are given for a continuous bright annealing furnace, a semi-muffle heat treating furnace, a gas-fired furnace with automatic control, a twin-chamber oil-fired furnace for heating billets, patent incandescent producer-gas fired normalizing furnaces for stamping, a gas-fired furnace of the suspended crown type, a 20-ft. tube annealing furnace, plate-heating recuperative furnaces, and gas-

fired sheet-mill furnaces. Comparisons are made of the various types of fuel with each other and with electricity, showing over-all thermal efficiency and relative merits of each for specific purposes.

CONTACT CATALYSIS. Bernhard Neumann and Herbert Jüttner. *Zeitschrift für Elektrochemie*, February; pp. 87-96. Poisoning of contact catalysts by arsenic compounds has been investigated, with particular reference to sulphuric acid. Pure arsenic oxide is itself a catalyst of the oxidation of sulphur dioxide, but its activity in this respect is even less than that of iron oxide. The catalytic effect is due to alternate oxidation and reduction, involving arsenic trioxide and pentoxide, the oxidation stage being very rapid. Hence, if either oxide is added to a catalyst for which the oxidation rate is too slow, a promoter effect is obtained. This occurs, for instance, with the iron oxides; in one trial, added arsenic increased the yield to 78.5 per cent (from 69.5 per cent) at a conversion temperature lower by 63 deg. C. than with iron oxide alone. When the reduction is rapid enough, arsenic has no promoter action; with vanadium pentoxide it neither helps nor hinders. With the metal vanadates, however, arsenic oxides are active poisons of catalytic activity. In the case of the noble metals, which are considered to be adsorption catalysts rather than oxygen carriers, either metallic arsenic or its oxides will quickly poison the catalyst. With silver, this effect is so pronounced that even the catalytic effect of the arsenic oxide is nullified, as well as that of the silver. Tables and curves are shown for trials with iron oxide, vanadium pentoxide, the vanadates of copper and silver, and for metallic silver and platinum.

Recent Government Publications

Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated pamphlet is free and should be ordered from bureau responsible for its issue.

Census of Dyes and of Other Synthetic Organic Chemicals, 1928. U. S. Tariff Commission Tariff Information Series No. 38; 30 cents.

Indiana Oolitic Limestone, by G. F. Loughlin. U. S. Geological Survey Bulletin 811-C; 30 cents. Discusses relation of the natural features of this limestone to is commercial grading.

German Potash Industry in 1929, by Consul R. W. Heingartner, Frankfort on the Main. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 304; mimeographed.

Paper Trade and Industry of Japan, by B. M. Frost. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 672; 10 cents.

The Flow of Water in Riveted Steel and Analogous Pipes, by Fred C. Scobey. U. S. Department of Agriculture Technical Bulletin 150; 30 cents.

National Prohibition Enforcement Laws, November, 1929. Pamphlet of the Bureau of Prohibition.

Domestic and Industrial Fuel Oils. Bureau of Standards Commercial Standard CS12-29; 5 cents.

Alphabetical Index and Numerical List of Federal Specifications Promulgated by the Federal Specifications Board (Complete to Nov. 1, 1929). Bureau of Standards Circular 378; 5 cents.

Care and Adjustment of Folding Testers of the Schopper Type. Bureau of Standards Circular 379; 5 cents.

Salvage of Material in the Oil Industry, by C. P. Bowie. Bureau of Mines Technical Paper 461; 20 cents.

Ore Size and Blast-Furnace Economy, by S. P. Kinney. Bureau of Mines Report of Investigations 2983; mimeographed.

A Diaphragm or "Breather" Roof for Oil-Storage Tanks, by Ludwig Schmidt. Bureau of Mines Report of Investigations 2984; mimeographed.

Xylenols and Higher Phenols That Have Been Found in Primary Tars, by E. J. Schneider and J. B. Shohan. Bureau of Mines Report of Investigations 2968; mimeographed.

Barite and Barium Products, Part I—General Information, by R. M. Santmyers. Bureau of Mines Information Circular 6221; mimeographed.

Mineral production statistics for 1928—separate pamphlets from Bureau of Mines on: Abrasive Materials, by Oliver Bowles, 5 cents; Natural Gasoline, by G. R. Hopkins and E. M. Seeley, 5 cents; Lime, by A. T. Coons, 5 cents; Silica, 5 cents; Talc and Soapstone, by Oliver Bowles and B. H. Stoddard, 5 cents; Gypsum, by R. M. Santmyers and Jefferson Middleton, 5 cents; Manganese and Manganiferous Ores, by Lewis A. Smith, 10 cents; Pennsylvania Anthracite, by O. E. Kiessling and H. L. Bennit, 10 cents; Rare Metals, by Frank L. Hess, 10 cents; Mercury, by Paul M. Tyler, 5 cents; and Phosphate Rock, by B. L. Johnson, 5 cents.

Production statistics from 1927 Census of Manufactures—printed pamphlets on: Chemicals, Manufactures of Nonferrous Metals and Alloys and Aluminum Manufactures, Leather and its Manufactures, Iron and Steel, Converted Paper Products Industries, and Clay-Products Industries and Sand-Lime Brick.

Safety Reports. Bureau of Mines documents as follows: Industrial Gas Masks Abroad, by S. H. Katz, Information Circular 6206, Mimeographed; Advanced Mine Rescue Training, Part I. Mine Gases and Methods for Their Detection, by J. J. Forbes and G. W. Grove, Miners' Circular 33, 20 cents; Advanced Mine Rescue Training, Part II. Instructions in Methods of Sampling and in the Use of the Bureau of Mines Portable Orsat Apparatus for Analyzing Mine Gases, by W. P. Yant and L. B. Berger, Miners' Circular 34, 20 cents; and Safety at Natural-Gasoline Plants, by G. B. Shea, Technical Paper 462, 25 cents.

National Survey of Fuel Oil Distribution, 1928, by E. B. Swanson. A Bureau of Mines report printed by the American Petroleum Institute.

Portland Cement in December, 1929, and Summary of Estimates by Months and by Districts, 1929. Bureau of Mines Monthly Cement Statement No. C. P. 103, issued Jan. 20, 1930. Mimeographed.

Trade and Commercial Reports: Bureau of Foreign and Domestic Commerce documents as follows: Survey of Gray-Iron Foundries, Domestic Commerce Series 29, 15 cents; Iron and Steel Industry and Trade of Canada, Trade Information Bulletin 665, 10 cents; United States Trade with Latin America in 1928, Trade Promotion Series 88, 15 cents; Chemical Industry and Trade of Switzerland, Trade Information Bulletin 664, 10 cents; Market Data Handbook of the United States, bound volume, $2.50; and Commercial Structure of New England, Domestic Commerce Series 26, 95 cents.

Miscellaneous Publications

The Clays of Louisiana (Alexandria Area). By J. W. Whittemore. Department of Conservation, State of Louisiana, New Orleans. 277 pages. Continuation of the work already done in other areas.

Trade Standard Adopted by the Compressed Air Society, New York, 1930. 47 pages. Fifty cents, New standards and suggestions of the Society.

Asbestos: Reference to Material in the New York Public Library. By William B. Gamble. New York Public Library, 1929. 72 pages. Fifty cents.

Oxy-acetylene Committee Report. From Annual Meeting of the International Acetylene Association, 1929. New York. 86 pages.

Equipment for Gas-Liquid Reactions. By Donald B. Keyes. Circular No. 19, University of Illinois Engineering Experiment Station, Urbana, 1929. 14 pages. 10 cents.

THE PLANT NOTEBOOK

an exchange for OPERATING MEN

Determining Air Flow in Agitation Problems

By H. L. Kauffman
Consulting Engineer, Denver, Colo.

COMPRESSED AIR for agitation plays an important part in many operations, particularly in refineries. Air is employed in the treatment of lubricating oils and, where refineries do not have continuous treating plants, in the treatment of gasoline, kerosene and other light oils. Agitation is required also in the blending and compounding of lubricating oils, a thing that usually is accomplished by means of air—with or without mechanical agitation.

Air agitation is not recommended in the contact filtering of oils, but there are some occasions when the saving in time and other factors attained by the use of air counteracts its detrimental effects. Air is employed also in agitating gasoline when blending is being done in the tank, and it is desired to bring the whole contents of the tank to a pre-established grade. Oils also are "brightened" (that is, moisture is removed) by blowing the heated oil with air in bleaching tanks.

The violence of agitation that will be produced, under varying conditions, by different quantities of air is not commonly known, and it is to present this and similar information that the following data are presented.

The pressure required to produce agitation is the sum of three factors, namely: (1) The head of liquid in the tank; (2) the friction in the pipe; (3) the pressure difference required to force the air through the orifices or openings. For ordinary service, the following quantities of air per square foot of tank cross-sectional area can be relied upon when the depth of liquid is about 9 ft.:

	Free Air Per Min.
Moderate agitation	0.65 cu.ft.
Complete agitation	1.3 cu.ft.
Violent agitation	3.1 cu.ft.

For the same degree of agitation, and for a depth of 3 ft. (a condition often encountered in shallow bleaching tanks), approximately double the quantity of air is needed over that required for a depth of 9 ft. It is evident that the quantity of air required varies with the depth of liquid. When the depth is only 1 ft., the agitation is almost directly over the pipe. However, as the depth increases, the area agitated increases. Consequently, only about half the quantity of air is required for a depth of 1 ft. to secure the same degree of agitation.

Friction Loss in Pipes

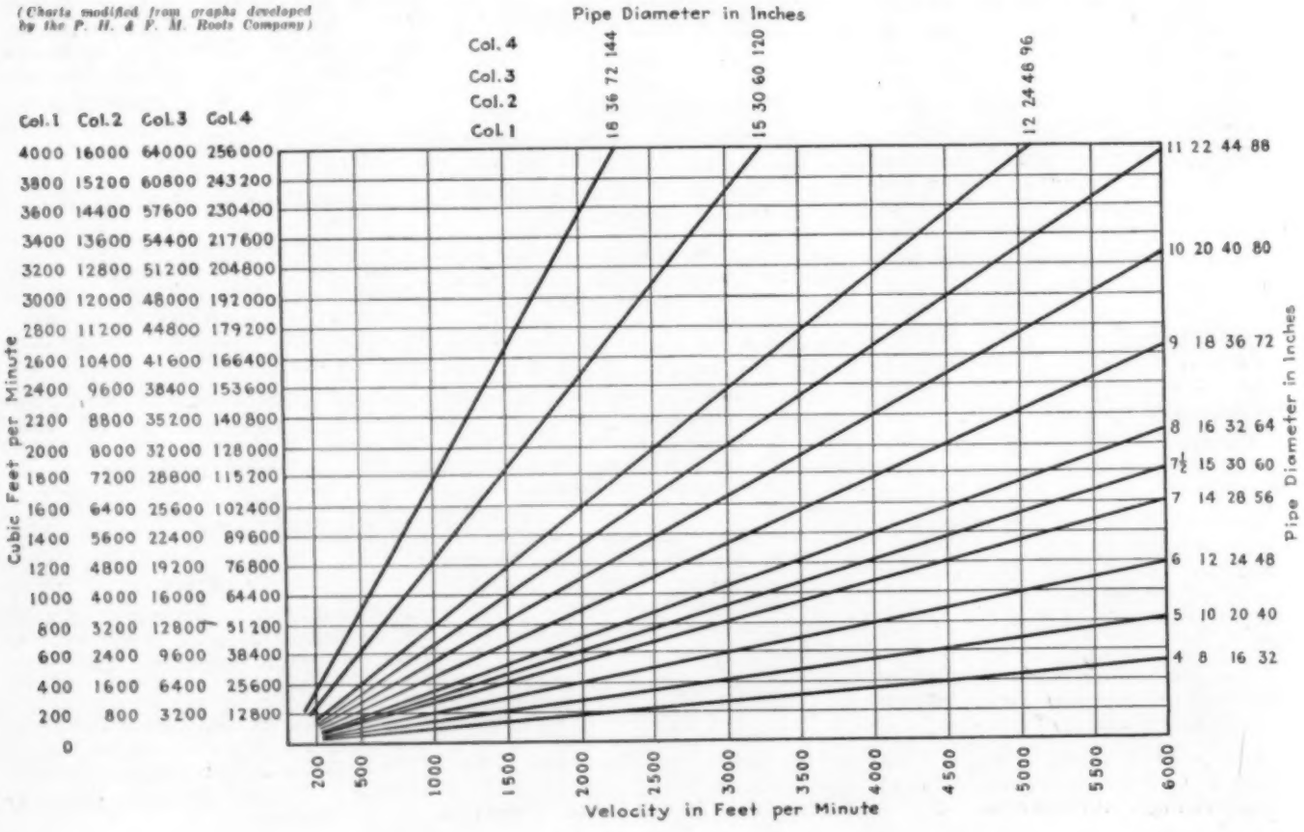
The charts given in Figs. 1 and 2 will aid in making calculations relative to the flow of air in pipes. Fig. 1 gives the relation between linear velocity and volume in pipes of different diameters. This chart solves the formula:

$$Q = \frac{60 \pi V D^2}{4 \times 144} = 0.327 V D^2 \quad (1)$$

Where Q = quantity of air flowing in cubic feet per minute, V = velocity in feet per second; and D = pipe diameter in inches.

The chart given in Fig. 2 is intended for finding the pressure loss due to pipe friction for pipe of various diameters when the quantity of air flowing per minute is known. This chart is derived as follows: Where Q, D, and V are as above, P = pressure loss in

Fig. 1—Chart Showing Relations of Flow, Velocity and Pipe Diameter for Air-Flow Calculations



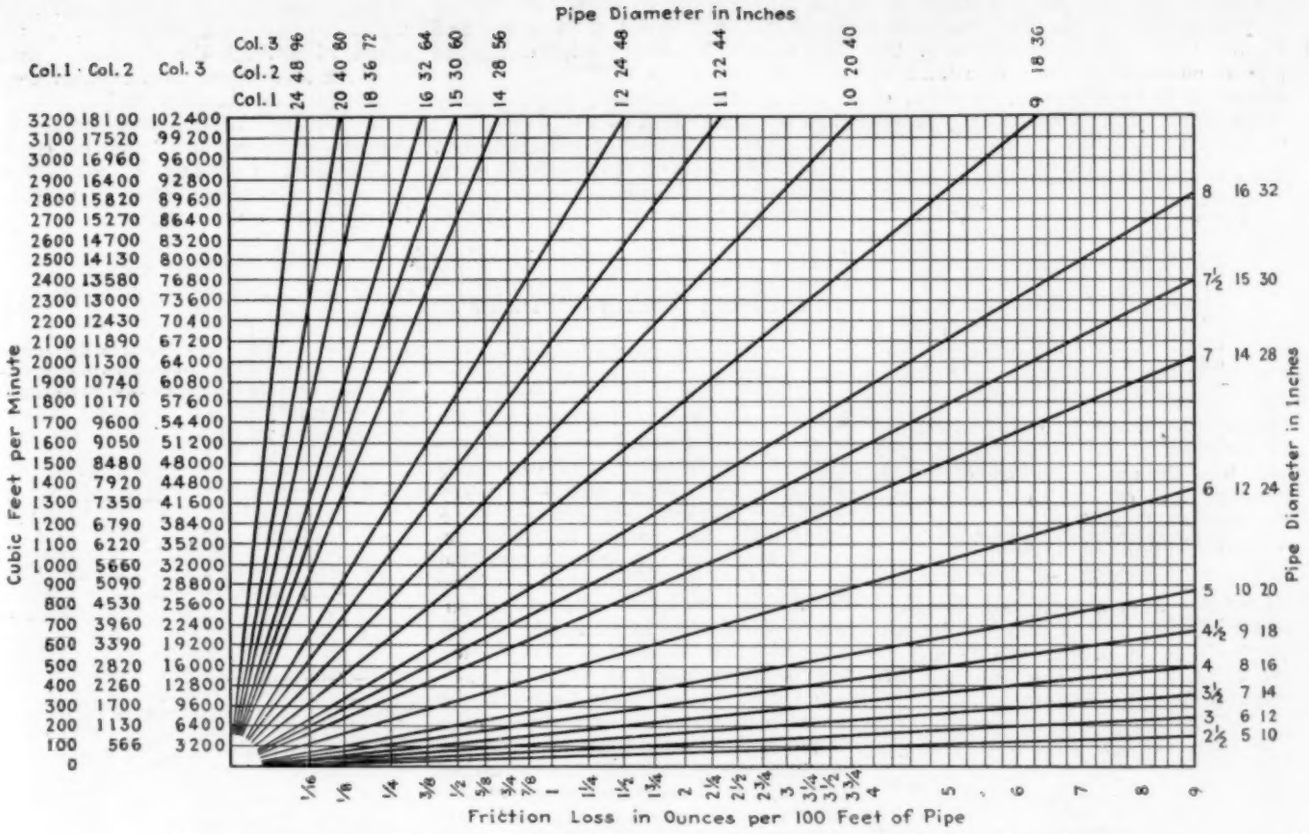

Pipe Diameter in Inches
Col. 1 · Col. 2 Col. 3
Col. 3
Col. 2
Col. 1
Cubic Feet per Minute
Pipe Diameter in Inches
Friction Loss in Ounces per 100 Feet of Pipe

Fig. 2—Interrelations of Air Flow, Pipe Diameter and Friction Loss for 100 ft. of Straight Pipe

ounces per square inch and L is length of pipe in feet

$$P = \frac{L V^2}{25{,}000 D}$$

but $$V = \frac{Q}{60 A} = \frac{3.05 Q}{D^2}$$

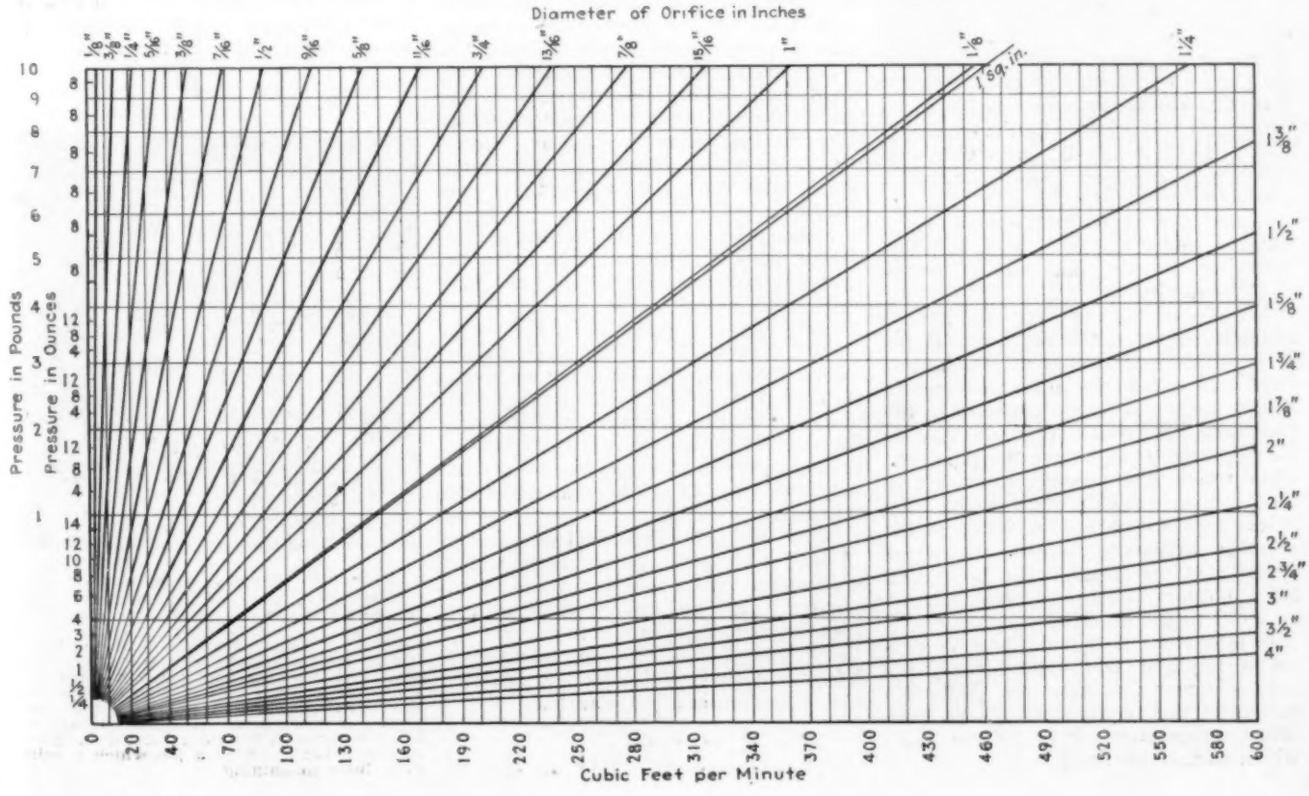
hence $$P = \frac{L \times 9.3 Q^2}{25{,}000 D^5} = \frac{Q^2 L}{2{,}690 D^5}$$

and when $L = 100$ ft.

$$Q = 5.176 D^{\frac{5}{2}} \sqrt{P} \qquad (2)$$

Since Fig. 2 determines pressure loss

Fig. 3—Chart for Determination of Air Flow Through Orifices of Various Diameters up to 4 In. at Pressures up to 10 lb.



per 100 ft. of pipe, for any length not exceeding 2,000 ft., the loss is multiplied by the total equivalent length of the pipe in hundreds of feet. Resistance of elbows is to be expressed in terms of equivalent straight pipe length by means of Table I:

Table I—Pipe Length Equivalent to Elbows

Radius of Elbow in Pipe Diameters	Equivalent Feet of Straight Pipe
5.0	7.8
3.0	8.4
2.0	9.0
1.5	10.3
1.25	12.7
1.0	17.5
0.75	35.0
0.5	121.0

Flow Through Orifices

The chart shown in Fig. 3 is for use in determining the volume of air that will flow through an orifice of known diameter and of any form under any pressure less than 10 lb. per square inch. This chart solves the formula:

$$Q = 21.7\ D^2\ C\ \sqrt{H} \qquad (3)$$

where H = head or pressure in inches of water column, C = a constant depending on kind of orifice, and Q and D are as above. The value of C for different orifices is as follows:

Conoidal mouthpiece, form of contracted vein	C = 0.97 to 0.99
Conical converging mouthpiece	C = 0.90 to 0.99
Short cylindrical mouthpiece rounded at inner end	C = 0.92 to 0.93
Thin plates, circular	C = 0.56 to 0.59
Short cylindrical mouthpiece	C = 0.81 to 0.84

The graphical results given in this chart were obtained using for C a value of 1. Therefore, the table reading should be multiplied by the actual value of C for the particular orifice under consideration. If it is desired to find the flow through a circular orifice not given in the chart, square the diameter in inches and multiply by the reading for the "1-in." orifice; or multiply area of orifice in square inches by the reading obtained from the "1-sq.in." line.

In this connection, the results of an investigation conducted by the engineers of the P. H. & F. M. Roots Company become of interest. These engineers conducted tests with 20 holes $\frac{1}{4}$-in. in diameter and with 20 holes of $\frac{1}{8}$-in. diameter under varying pressures. The following are the outstanding results of this experiment:

"The quantity of air discharged through orifices under the water is the same as the quantity of air discharged from orifices into the atmosphere under a pressure equal to the pressure in the pipe less hydrostatic pressure due to the depth of water above the pipe. In other words, the pressure necessary to force a given quantity of air through the holes when submerged in water is the pressure necessary to force the same quantity of air through the holes into the atmosphere plus the hydraulic pressure due to the depth of water."

It is obvious that the degree of agitation required will depend upon the process under consideration. Determination of the requirement should take into consideration three related facts which summarize the foregoing:

1. The degree of agitation depends upon the quantity of air flowing, and also upon the velocity with which the air leaves the holes.

2. Agitation increases more rapidly than the rate of flow of air.

3. Better agitation is obtained with deep tanks than with shallow tanks using the same quantity of air in each case. This is due to the fact that the agitation is largely caused by the expansion of air as it rises in the liquid; also, by the speed with which the air rises. Both of these factors are greater with deep tanks than with shallow tanks.

In conclusion, the author wishes to express appreciation to the P. H. & F. M. Roots Company for permission to use the charts and other information incorporated in this article.

Indirect Volume Finder

By Lawrence Hodges
Design Engineer, Baltimore, Md.

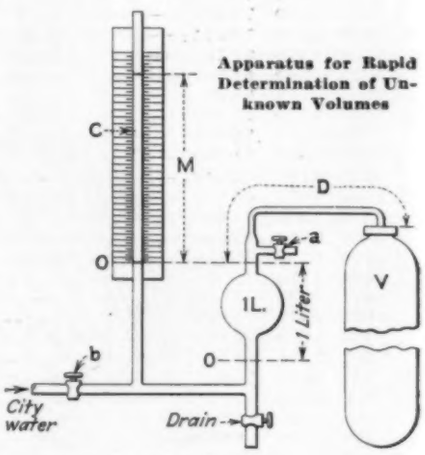
Some time ago the writer had the problem of determining the volumes of about 200 containers of approximately the same size. While this might have been done by water displacement or by determining the weight of water required to fill each, it was thought that the use of an indirect method would be simpler, in view of the number of containers that had to be examined. It was suggested that the application of Boyle's law, in an apparatus in which the container was placed under pressure by means of a water column, would be a simple and accurate method. The apparatus shown in the accompanying drawing was devised as a result of this suggestion. It proved to be entirely satisfactory, easily giving results which were accurate to 1 per cent, as checked by water displacement.

Operation of the apparatus is simple. Air valve, *b*, is opened and water is run in by cracking valve, *a*, until the water level stands at the zero mark below the 1-liter standard. This standard may be any other convenient known volume; for example, 1 gallon. After the water is at the zero mark, valve *a* is closed and then valve *b*. Then water is again run in slowly until the level is at the 1-liter mark. This must be done slowly, so that the heat of compression of the air in the system will be dissipated before the liter mark is reached. Otherwise, a distinct change in level may occur after the air has cooled to room temperature.

When the level has reached the 1-liter mark it is obvious that the pressure above the water in the connection tube and container which is being measured will be balanced by the water in the manometer, *c*. The head in the manometer will, of course, be read above its zero point, which corresponds to the zero of the liter container. This head, M, and the barometer reading, which is to be determined in inches of water, are the only variables that must be measured.

Now, let P be the barometric pressure in inches of water column; M be the manometer reading, also in inches of water; V the unknown volume of the container under examination; and D the volume of the connecting tube which has previously been determined. Making use of Boyle's law, we find that

$$P(V + D + 1) = (P + M)\ (V + D) \quad \text{or}$$



Apparatus for Rapid Determination of Unknown Volumes

$$P = VM + DM$$

$$\frac{P}{M} = V + D$$

$$V = \left(\frac{P}{M} - D\right) \text{liters.}$$

If D be made part of the standard volume, which is not difficult, the calculations are simplified and the expression becomes simply $V = \frac{P}{M}$. Since the barometer does not ordinarily change rapidly, it is therefore only necessary to read it occasionally during a run, recording for most of the containers only the reading of the manometer, M.

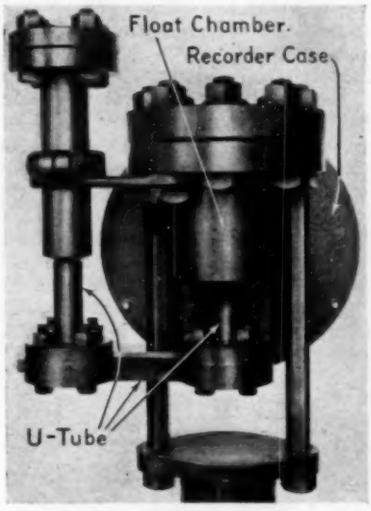
Don't Discard Worn Gears

This gear, part of a large limestone crusher, was speedily reclaimed by welding, at small cost and without serious delay at the mill. The plant welder is shown building up the worn teeth with a welding blowpipe and welding rod. Gears no larger than this seldom require more preheating than can be accomplished with the blowpipe. A preheating torch or temporary brick furnace will suffice for larger gears. A good welder can do a job which requires very little machining.

EQUIPMENT NEWS
from MAKER *and* USER

High-Pressure Meter

FOR PRESSURES from 0 to 5,000 lb. per square inch, the Foxboro Company, Foxboro, Mass., has developed a new flow meter intended for measuring the flow of gas, air, steam, hot oil and gasoline. The accompanying photograph, showing a back view of this instrument, shows the heavy construction of the mercury manometer and float chamber. All pressure parts



Rear View of High-Pressure Flow Meter for Gases, Vapors and Liquids

are drop forgings, especially designed for high-pressure work. These meters may be obtained with or without the integrating feature recently introduced by this company on its steam flow meters. Meters are calibrated to read and integrate directly in terms of flow.

Hascrome Welding Rod

A MANGANESE-chrome-iron welding rod known as "Hascrome" is announced by the Haynes Stellite Company, Kokomo, Ind. This is a self-hardening alloy intended primarily for building up badly worn parts preparatory to surfacing them with Stellite. The new alloy is said to form an excellent base for Stelliting because of its hardness and the ease with which Stellite flows onto it. At the same time, the composite surface resulting when the two alloys are used is much cheaper than if the parts were built up entirely of Stellite. Hascrome has sometimes been used alone for hard-surfacing parts worn but its abrasion resistance is not equal to Stellite.

It is recommended that Hascrome be applied by means of the oxyacetylene process as the hardness of the metal can be controlled by the amount of excess acetylene in the flame. Rate of cooling also controls the hardness. A change in these two factors makes possible coatings with a Brinell hardness ranging from 240 to 500. Arc-welded deposits, using reverse polarity, have a hardness varying from 240 to 400 Brinell. Coated rods are said to give better results with arc welding than the uncoated.

Heat Exchanger

A NOVEL DESIGN of counter-current heat exchanger has been developed by the Foster Wheeler Corporation, 165 Broadway, New York City. The new exchanger is built expressly for the cooling of light oils to the lowest temperature obtainable with a given water supply. It is claimed that in the usual type of baffled counter-current exchanger, short-circuiting is possible around the baffles. The new design consequently has been built around a baffle permanently welded into the shell. This design has necessitated certain changes in the construction of the tube bundle and the movable tube sheet. Reference to the accompanying drawing will make this construction evident.

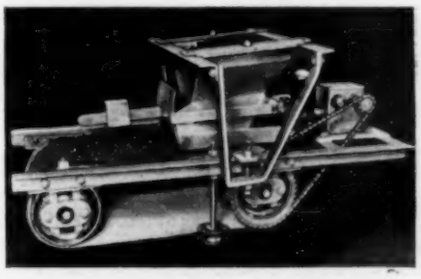
Tubes are secured to the fixed tube sheet, at the right of the drawing, in the usual manner. In order, however, that the tube bundle may be slipped into the shell from the left while the baffle is in place, it is necessary to have the bundle, and also the movable tube sheet, split in a horizontal plane.

Liquid travels from right to left through all of the tubes on one side of the baffle and from left to right through the tubes on the other side. In order to accomplish the crossover at the movable end, two half rings are placed over the end of the movable sheet and bolted to the movable head. A tongue attached to the center of each half ring closes the split through the tube sheet.

This construction is said to give a movable support for the free end of the tubes, at the same time insuring against the possibility of any leakage of the cooling fluid around the baffle and making certain of true counter-current flow of both fluids.

Weighing and Sizing Equipment

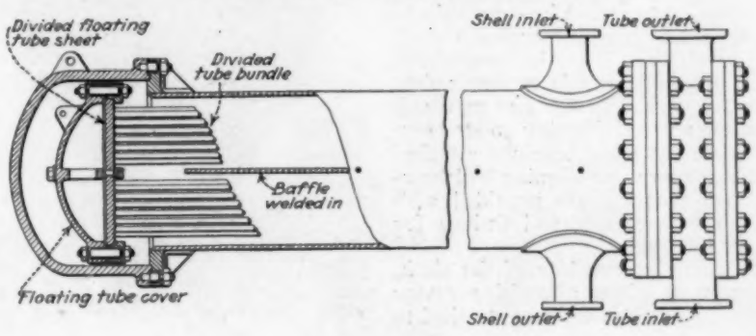
TWO RECENT developments, one a constant-weight feeder, and the other a sizing attachment for conical ball mills, are reported by the Hardinge Company, York, Pa. The first, shown in the accompanying photograph, consists of a traveling belt attached to a frame on which the driving mechanism also is located. This is suspended on a pair of knife edges and balanced by means of a movable weight. Any variation in weight on the belt moves the frame and in turn adjusts a feed gate at the bottom of the hopper so as to control the weight of the material supplied to the belt.



View of Hardinge Constant Weight Feeder

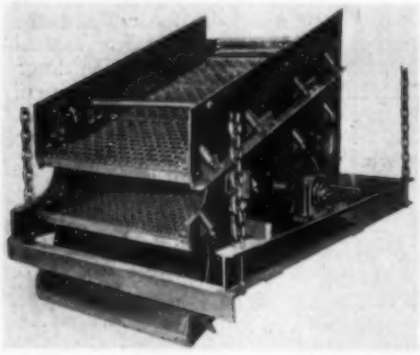
A revolution indicator is provided so that it is possible to record the weight for any given period. The feeder is self-contained, requiring no auxiliary

Partial Section of New Heat Exchanger Showing Split Tube Bundle and Method of Connecting Movable Head



driving mechanism. A control device which can be supplied makes it possible to vary the feed at will at any desired distance from the feeder itself. These machines are available in capacities ranging from 100 lb. to over 100 tons per hour per unit.

The second development, known as the Hardinge paddle grate, consists of four perforated scoops or paddles which are installed in the discharge end of a conical ball mill operating on the wet system. As the material discharges from the mill, it is swept by the paddles which revolve with the mill. As paddle travel is much faster than the pulp flow, finer material passes through the screens and out of the mill. The oversize rolls into troughs attached to the bottom of the paddles and is thrown back into the mill for regrinding. Although the pulp is screened, it is pointed out that it is not impeded in any way as it passes through the grate zone.



Three-Deck Vibrating Screen Showing Screen Clamps, Flywheel and Supporting Chains

Vibrating Screen

POSITIVE VIBRATION of screening surfaces is assured by a new vibrating screen manufactured by the Stephens-Adamson Manufacturing Company, Aurora, Ill. The new screen is made in single, double, and triple deck models, and in six sizes ranging from 2x4 ft. to 5x8 ft. Four standard rotor assemblies are available for each size, the rotor used depending upon the service.

As shown in the accompanying illustration, the new screen consists of a structural steel sub-frame which is suspended by chains from any supporting structure. This arrangement prevents the transmission of lateral vibration to the supports. The screen decks are supported upon a transverse shaft which carries two heavy balance wheels and is ground eccentric at two points where the deck bearings are mounted. The latter are self-aligning roller bearings, while the main bearings attached to the frame are self-aligning ball bearings. All bearings are provided with labyrinth grease seals and fittings for pressure lubrication.

Due to the eccentricity of the shaft, the screen is given a positive rotary motion. Adjustable weights attached to the flywheels compensate for this motion and prevent the transmission of vibration to the sub-frame. Four vertical adjustment rods carried on independent springs prevent overturning of the screen body and provide a means for changing the screen angle. A tubular cross member incloses the deck bearings and the center portion of the shaft, and ties the two sides of the deck together.

Screens are welded to frame members and are easily inserted into the decks beneath clamps which are lifted by springs when their fastening bolts are loosened. The motor is mounted upon the sub-frame and drives the shaft through a multiple-V-belt. Motors are fully inclosed and vary with the service in size from 2 to 10 hp.

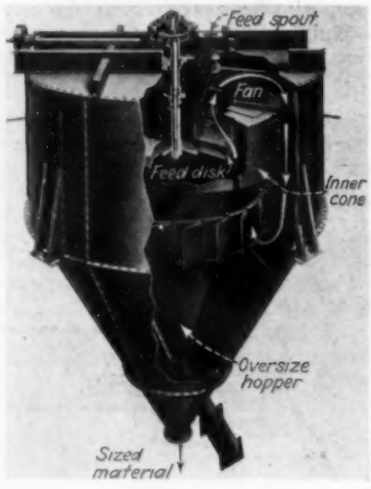
Dome Reflector

A BAYONET coupling similar to the type applied to its Type 79 Glassteel Diffuser, which was recently described in these columns, has been applied by the Benjamin Electric Manufacturing Company, Des Plaines, Ill., to its type RLM dome reflector. The fixture consists of only two separable parts: the hood, which contains the wiring terminal base and the removable reflector with the lamp-holding element. These two parts are coupled together by means of a bayonet coupling which locks the hood and reflector units securely together, at the same time completing the electrical connections. This system is said to result in easy wiring, easy cleaning and low maintenance cost.

Mechanical Separator

FOR FINE GRINDING it is now generally recognized that close-circuiting of the mill with some form of separator is highly desirable. A new mechanical air separator has been added to the line of grinding and separating equipment made by Raymond Bros. Impact Pulverizer Company, 1302 North Branch St., Chicago. In appearance the mill is shown by the accompanying photograph to be somewhat similar to other mechanical air separators, but a feature called a "whizzer," not shown in the photograph, is said to be responsible for the very close separation which the manufacturers claim for this machine.

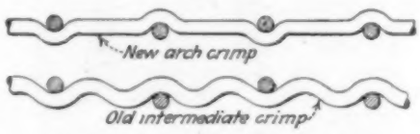
Cutaway View of New Mechanical Air Separator



Discharge from the mill is elevated and fed through a spout in the top of the separator to a rapidly rotating disk which throws the material across the air space between the disk and the inner cone of the separator. A large volume of air, circulated by the fan at the top of the separator, picks up all of the material and carries it upward where it comes in contact with the "whizzer," which is a many-bladed device operating against a cone-shaped ledge attached to the inside of the inner cone. This device is said to give a very positive and definite classification of the material, knocking oversize out of the air stream. Thus, according to the manufacturer, the separation is entirely mechanical and is not affected by the velocity of the air.

Fine material which passes the "whizzer" then continues up through the fan and down between the inner and outer cones. The solids continue down to the bottom of the outer hopper while the air passes through deflector doors and continues its circulation.

The separator is said to be strongly constructed, with all moving parts easily accessible. Special liners are available for handling particularly abrasive material. Output is said to be large and power consumption low.



Above Is a Cross-Section of Arch-Crimp Screen as Compared with the Old Intermediate Crimp Screen Below

Improved Screen

"ARCH-CRIMP" woven-wire screen for coarse sizing is a new product developed by the Ludlow-Saylor Wire Company, St. Louis, Mo. This type of screen is said to have been developed especially for severe service, as on vibrating and revolving screens. It is said to keep its shape and accuracy until the steel is worn away. The construction of the screen is best explained in connection with the accompanying drawing, which clearly shows wherein it differs from the old type screen.

Rubber Face Mask

AN IMPROVEMENT to its line of gas masks has been announced by Bullard-Davis, Inc., 67 Wall Street, New York City. This consists of a rubber face piece which is said to have a markedly increased tendency to hold shape and to possess superior resistance to wear. The exhalation valve has been located so as not to interfere with head motion in any direction.

Starting Equipment

TWO new starting devices are being offered by Cutler-Hammer, Incorporated, Milwaukee, Wis. Both are for use with direct-current motors up to 2 hp. and 115 or 230 volts. Both are automatic in operation, but one connects directly across the line and the other is of the counter emf. type. In the latter, pressing the starter button connects the motor to the line through an armature resistor. As the motor accelerates to the proper point, the counter emf. of the motor armature closes the accelerating contactor which cuts out the armature resistor, connecting the motor across the line.

Principal features are said to include small size, thermal overload protection, low voltage protection and renewable silver contacts. The starters may be obtained without the thermal overload protection if desired.

Improved Flexible Couplings

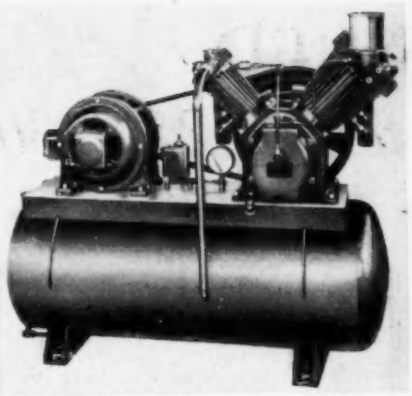
IMPROVEMENT in its line of standard couplings is announced by the Poole Engineering & Machine Company, Baltimore, Md. The standard Poole coupling, it will be remembered, consists of two sleeves carrying on their surfaces external gears, one sleeve of which is mounted on each of the driving and driven shafts. A second sleeve surrounding the first two, contains two internal gears and transmits the motion from the driving to the driven sleeve. In the improved form the external sleeve has new double-flanged end plates, the outer sections of which are grooved and drilled with back drain holes to permit lubrication of the coupling while in motion.

Improved Weld Feeder

TO MEET the increased use of arc welding at speeds requiring heavier welding current and larger sizes of electrode wire, the General Electric Company, Schenectady, N. Y., has developed an improved feeding device on its automatic welding head. This improvement consists in the addition of geared drive to what was formerly the idler roller in the feeding mechanism. It is said that this makes possible a positive feed for large sizes of wire which are stiff and ordinarily hard to handle without excessive pressure on the driving rolls. The improved welding head accommodates wire from $\frac{1}{8}$ to $\frac{1}{4}$ in. in diameter without changing gears.

Unit Air Compressors

FOUR SIZES, varying from $\frac{3}{4}$ to 5 hp., of a new air-cooled, two-stage air compressor, known as type 30, have been announced by Ingersoll-Rand Company, 11 Broadway, New York City, As shown in the photograph, the units are self-contained, with the motor and compressor mounted upon the air receiver. The latter is built for a working pressure of 200 lb. Both motor and compressor have ball bearings and are connected by means of a V-belt drive. Compressors are provided with automatic stop and start control, governed by the receiver pressure. Other features include a self-cleaning air cleaner, balanced crankshaft, and an inter-cooler located behind the fan-type flywheel.



Two-Stage Unit Type Air Compressor

Manufacturers' Latest Publications

Apparatus. Refinery Supply Co., 621 E. 4th St., Tulsa, Okla.—Folder 14—Describes instruments and apparatus for the natural and artificial gas and gasoline industries, for laboratory and plant.

Chemical Engineering. Swenson Evaporator Co., Harvey, Ill.—Article IX—Prepared by Prof. W. L. McCabe as the ninth of a series of articles on "Heat Transfer and Crystallization." The title of this article is "Theory of Industrial Crystallization."

Chemicals. Diamond Alkali Co., Pittsburgh, Pa.—Second edition of the "Diamond Alkali Handbook," describing the company's facilities and products, and giving tables, charts, and formulas for use in connection with alkalis and chlorine. 22 pages.

Concrete. Johns-Manville Corp., 292 Madison Ave., New York, N. Y.—27-page revised booklet describing the uses of Celite for concrete.

Electrical Equipment. Cutler-Hammer, Inc., Milwaukee, Wis.—Publication CS-21—Describes a new single-pole switch with thermal overload protection for small motors. Also Publication CS-20, a booklet reprinting four articles from *Power*, describing practical pointers on the selection of motor controls.

Electrical Equipment. General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-19F, Inclosed Magnetic Switches for A.-C. Motors; GEA-904C, Single-Stage Centrifugal Air Compressors; GEA-474A, Truck-Type Switching Equipment; GEA-945A, Manually Operated Air Circuit Breakers; GEA-1049A, Control and Instrument Switches; GEA-1196, Air Circuit Breakers; GEA-1231, Quiet-Operating Induction Motors; GEA-1232, 24 pages on electric equipment for handling heavy material; GES-403A, 27-page list of motion pictures and illustrated lectures available on request from the General Electric Company.

Electric Furnaces. American Electric Furnace Co., Boston, Mass.—Loose-leaf catalog of furnace equipment of various types made by this company.

Electric Furnaces. Freas Thermo-Electric Co., 1206 So. Grove St., Irvington, N. J.—Folder announcing a new series of electrically-heated forced-air-circulation ovens.

Electric Furnaces. Hevi Duty Electric Co., Milwaukee, Wis.—Catalog 30—32 pages giving detailed descriptions of laboratory furnaces and hot plates. Bulletin 230, electric conveyor furnaces of the floating belt type.

Grinding. Hardinge Co., York, Pa.—Bulletin 13B—56-page catalog illustrated with photographs and drawings, describing conical ball mills and accessories.

Heaters. Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia, Pa.—Bulletin 3A—Describes the various steam-jet heaters for water and other liquids made by this company.

Heating. General Gas Light Co., Kalamazoo, Mich.—11-page booklet describing the Humphrey gas unit heater, No. 100.

Instruments. Brown Instrument Co., Philadelphia, Pa.—Catalog 7501—Describes remote type indicating and recording instruments for pressure, level, flow and position.

Instruments. Esterline-Angus Co., Indianapolis, Ind.—Bulletin 130—Describing instruments for recording position and thickness.

Instruments. Foxboro Co., Foxboro, Mass.—New loose leaf sheets describing pressure and flow controllers; also diaphragm valves and diaphragm levers; also Bulletin 165, describing gas meters with integrating and recording features.

Instruments. Leeds & Northrup Co., 4901 Stenton Avenue, Philadelphia, Pa.—Recent bulletins concerning reduced prices of galvanometers and discussing potentiometers, pyrometers for flue gas temperatures, and a partial list of Wheatstone bridges made by this company.

Instruments. Mine Safety Appliances Co., Thomas and Meade Sts., Pittsburgh, Pa.—Folder describing the Jones Gas Detector for determining the approximate explosive content or oxygen deficiency of atmospheres in confined spaces.

Instruments. Thwing Instrument Co., 3339 Lancaster Ave., Philadelphia, Pa.—Folder briefly describing the new model 30 pyrometer made by this company.

Lighting. General Electric Vapor Lamp Co., Hoboken, N. J.—A folder describing the advantages of Cooper-Hewitt Light.

Material Handling. Stephens-Adamson Mfg. Co., Aurora, Ill.—Catalog 30—Extremely complete catalog and handbook of 950 pages describing the complete line of conveying, elevating, screening, and transmission machinery made by this company. Many useful tables of engineering data are included.

Metals and Alloys. Cramp Brass & Iron Foundries Co., Richmond & Norris Sts., Philadelphia, Pa.—Bulletin 10—Describes Parsons' White Brass S. A., for bearings.

Metals and Alloys. Haynes-Stellite Co., Kokomo, Ind.—23-page booklet describing the uses and red-hardness of Haynes Stellite, as well as the chemical and physical properties and structure of this material.

Metal and Alloys. International Nickel Co., 67 Wall St., New York, N. Y.—January, 1930, Buyers' Guide of nickel alloy steel products, listing manufacturers of many types of shapes, parts and equipment.

Paper Machinery. Cameron Machine Co., 61 Poplar St., Brooklyn, N. Y.—Bulletin describing roll winders and slitters. Bulletin describing "Camachine" No. 19, a high speed winder for news and book mills.

Power Generation. De Laval Steam Turbine Co., Trenton, N. J.—15 page catalog concerning small water turbines.

Power Transmission. Reeves Pulley Co., Columbus, Ind.—Folder T-5555—Describes various types of Reeves variable speed transmissions and shows applications.

Pressing. Terkelson Machine Co., 326 A St., Boston, Mass.—Folder describing electrically-operated mechanical presses for molding.

Pumps. Goulds Pumps, Inc., Seneca Falls, N. Y.—Bulletin 400—"Pump-Fax," a 53-page handbook of data and information on the characteristics, installation and operation of pumps, compiled by F. G. Switzer, Cornell University. It contains much useful data and many valuable tables.

Pumps. Luitwieler Pumping Engine Co., 123 Ames St., Rochester, N. Y.—Folder describing the "Multipellor" turbine type deep-well pumps made by this company.

Pumps. P. H. & F. M. Roots Co., Connersville, Ind.—Bulletins 32-B1 and 33-B2—Describing respectively new standard and heavy duty gas pumps equipped with roller bearings.

Refractories. General Refractories Co., 106 So. 16th St., Philadelphia, Pa.—Pamphlet 3163—describes the record of "Arcofrax," high alumina brick used in hot zone linings in cement kilns of one company.

Screens. Stephens-Adamson Mfg. Co., Aurora, Ill.—16-page catalog describing a new vibrator screen made by this company.

Storage Tanks. Chicago Bridge & Iron Works, 37 W. Van Buren St., Chicago, Ill.—New 22-page booklet describing the use of the Wiggins Breather Roof on tanks, for storage of volatile liquids.

Valves. Edward Valve & Mfg. Co., East Chicago, Ind.—Folder illustrating various types of valve made by this company.

PATENTS ISSUED
Feb. 4 to Feb. 25, 1930

Pulp, Paper and Glass

Paper-Machine Drier. William H. Millspaugh, Sandusky, Ohio, assignor to Paper & Textile Machinery Company, Sandusky, Ohio.—1,745,685.

Paper-Making Machine. Frank A. Peschl, Jackson Heights, N. Y.—1,745,687.

Process of Making Pulp. Sidney D. Wells, Quincy, Ill., assignor to Paper Mill Laboratories, Inc., Quincy, Ill.—1,746,451.

Process of Manufacturing Cellular Aggregate. Richard L. Lloyd, New York, N. Y., assignor to Dwight & Lloyd Metallurgical Company, New York, N. Y.—1,746,860.

Paper and Process of Making the Same. Dezier Finley, Berkeley, Calif., assignor to the Paraffine Companies, Inc., San Francisco, Calif.—1,747,232.

Paper-Web-Feeding Machine. Samuel J. Campbell, Green Bay, Wis., assignor to Hudson-Sharp Machine Company.—1,747,857.

Laminated Glass and Process of Producing the Same. James W. H. Randall, New York, N. Y., assignor to Libbey-Owens Glass Company, Toledo, Ohio.—1,748,079-80.

Process and Apparatus for Producing Sheet or Plate Glass. John L. Drake, Toledo, Ohio, assignor to Libbey-Owens Glass Company, Toledo, Ohio.—1,748,115-6.

Apparatus for Manufacturing Fiber Board or Analogous Material. James J. Hinde, Sandusky, Ohio.—1,748,224.

Esterification of Cellulose Materials. Birkett Wylam and John Thomas, Grangemouth, Scotland, assignors to Scottish Dyes, Ltd., Grangemouth, Stirling, Scotland.—1,748,689.

Rubber, Rayon and Plastics

Rubber Substance and Process of Making Same. Hermann Beckmann, Berlin-Zehlendorf, Germany.—1,745,657.

Method of Preserving Rubber. Jan Teppema, Akron, Ohio, assignor to Goodyear Tire & Rubber Company, Akron, Ohio.—1,746,371.

Synthetic Gummy or Resinous Material and Process of Making Same. Frederick W. Skirrow, Shawinigan Falls, Quebec, Canada, assignor to Canadian Electro Products Company, Ltd., Montreal, Canada.—1,746,615.

Primer Containing Synthetic Products. Carleton Ellis, Montclair, N. J., assignor to Ellis-Foster Company.—1,745,893.

Lacquer. Irvin W. Humphrey, Dover, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,746,895.

Process of Uniting Parts of Artificial Resin and Article Made Thereby. Johann Karl Wirth, Berlin-Altglienicke, Germany.—1,747,964.

Petroleum Products and Refining

Process of Treating Acid Sludge and Fuel Product Obtained Therefrom. Ralph A. Halloran, Berkeley, William N. Davis, Oakland, and George A. Davidson, San Francisco, Calif., assignors, by mesne assignments to Standard Oil Company of California, San Francisco, Calif.—1,745,692.

Art of Pressure Distillation. Robert E. Humphreys, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,745,931.

Art of Separating Hydrocarbons. Warren K. Lewis, Newton, Mass., assignor to Standard Oil Development Company.—1,746,197.

Vacuum Distillation and Rectification of Paraffin Distillate. Nathaniel E. Loomis, Elizabeth, N. J., and Warren K. Lewis, Cambridge, Mass., assignors to Standard Oil Development Company.—1,746,198.

Process for the Production of Paraffin-Hydrocarbons With More Than One Carbon Atom. Franz Fischer and Hans Tropsch, Mulheim-on-the-Ruhr, Germany.—1,746,464.

The Patents Page

A. How useful is this page to you?
B. Do you read it regularly?
C. How can it be made to serve you better?

An answer to these questions and any additional comments you care to offer will assist the editors of *Chem. & Met.*, in making this page of maximum usefulness to you as a reader. Your interest will determine whether or not this department is to be discontinued or modified. Address to: Editor of *Chem. & Met.*, 10th Ave. & 36th St., New York.

Apparatus for Refining Oil. George H. Taber, Jr., Rye, N. Y., assignor to Sinclair Refining Company, New York, N. Y.—1,746,915-6.

Art of Cracking Hydrocarbon Oils. Eugene C. Herthel and Thomas de Colon Tifft, Chicago, Ill., assignors to Sinclair Refining Company, New York, N. Y.—1,747,437.

Decolorizing and Color-Stabilizing Hydrocarbon Oil. Vanderveer Voorhees, Whiting, Ind., assignor to Standard Oil Company, Whiting, Ind.—1,747,806.

Process for the Conversion of Hydrocarbon Oils. George F. Benhoff, Philadelphia, Pa.—1,748,201.

Autonomous Apparatus for Neutralizing and Bleaching Heated Oleaginous Liquids Under Vacuum. Edouard Bataille, Paris, France.—1,748,274.

Fractionating System. Maurice B. Cooke, Plainfield, N. J., assignor to Atlantic Refining Company, Philadelphia, Pa.—1,748,411.

Process of Producing Stable Hydrocarbon Oils. Benjamin T. Brooks, Sound Beach, Conn., assignor to Gray Process Corporation, Newark, N. J.—1,748,507.

Method of Fractionation. Maurice B. Cooke, Plainfield, N. J., assignor to Atlantic Refining Company, Philadelphia, Pa.—1,748,508.

Method of Fractionation. Richard B. Chillas, Jr., Philadelphia, and Albert G. Peterkin, Jr., Bryn Mawr, Pa., assignors to Atlantic Refining Company, Philadelphia, Pa.—1,748,595.

Fractionating Column. Richard B. Chillas, Jr., Philadelphia, and Albert G. Peterkin, Jr., Bryn Mawr, Pa., assignors to Atlantic Refining Company, Philadelphia, Pa.—1,748,704.

Coal Processing and Products

Process of Producing Enriched Water Gas. Alfred Schwarz, Upper Montclair, N. J., assignor to Coal & Oil Products Corporation.—1,745,454.

Standpipe for Coke Ovens. Joseph Van Ackeren, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,747,610.

Ammonia-Recovery Process. Joseph Becker, Pittsburgh, Pa., assignor to Koppers Company, Pittsburgh, Pa.—1,747,616.

Natural-Gas Liquefaction. Horace Dumars, New Suffolk, N. Y., assignor, by direct and mesne assignments, of two-thirds to Bowen-Dumars Power Corporation, New York, N. Y.—1,747,761.

Coke Oven. Carl Otto, Hellerup, Denmark.—1,748,142.

Method for Heating Coke Ovens. Carl Otto, Essen-on-the-Ruhr, Germany.—1,748,143.

Organic Processes

Preparation of Cyanamides of the Alkaline-Earth Metals and Magnesium. Nikodem Caro, Albert Rudolph Frank, Hans Heinrich Franck, and Hugo Heimann, Berlin, Germany.—1,745,350.

Process for the Preparation of Metallic Cyanamides or Mixtures Containing Them. Hans Heinrich Franck and Hugo Heimann, Berlin, Germany.—1,745,753.

Apparatus for the Production of Carbon Black. Josef Machtolf, Celle, Germany, assignor to the Firm Chr. Hostmann-Steinberg'sche Farbenfabriken G. m. b. H., Celle, Germany.—1,746,003.

Process for the Preparation of Phosgene. Roger Williams, Wilmington, Del., assignor to Du Pont Ammonia Corporation, Wilmington, Del.—1,746,506.

Method of Producing Cymene. Irvin W. Humphrey, Wharton, N. J., assignor to Hercules Powder Company, Wilmington, Del.—1,746,532.

Catalyst and Catalytic Process. Wilbur A. Lazier, Wilmington, Del., assignor to E. I. duPont de Nemours & Company, Wilmington, Del.—1,746,781-3.

Treatment of Hydrocarbons with Electric Arcs. Paul Gmelin, Mannheim, and Otto Eisenhut, Heidelberg, Germany, assignors to I. G. Farbenindustrie Aktiengesellschaft, Frankfort-on-the-Main, Germany.—1,746,934.

Process of Treating Dye Effluents. Paul Mahler, New York, N. Y., assignor to Darco Sales Corporation, New York, N. Y.—1,747,175.

Asphaltic Emulsion and Process of Making. Charlton Wilder, Cincinnati, Ohio, assignor to Crown Rock Company, Cincinnati, Ohio.—1,747,653.

Process of Producing Organic Mercury Compounds. Max Engelmann, Wilmington, Del., assignor to E. I. duPont de Nemours & Company, Wilmington, Del.—1,748,331.

Process for the Manufacture of Alcohol. William L. Owen, Baton Rogue, La., assignor, by mesne assignments, to the citizens of the United States.—1,748,791.

Inorganic Processes

Method for Making Solutions of Salts of Alkali Metal and Aluminum. Hans Brenek, Aachen, Germany, assignor to the Firm Rhenania Verein Chemischer Fabriken AG, Aachen, Germany.—1,745,734.

Manufacture of Chlorine. Frank S. Low, Niagara Falls, N. Y., assignor to Westvaco Chlorine Products, Inc., New York, N. Y.—1,746,542.

Process for Purifying Mono Potassium Phosphate. Robert D. Pike, Piedmont, and Ross Cummings, Berkeley, Calif.; said Cummings assignor to said Pike.—1,746,905.

Process of Digesting Phosphate Rock. William H. Lohmann, Wilmington, Del., assignor to General Chemical Company, New York, N. Y.—1,747,588.

Material Comprising Calcium Sulphate Anhydrous and Calcium Phosphate Pyro and Method for Manufacturing Same. Charles B. Durgin, Anniston, Ala., and Paul Logue, St. Louis, Mo., assignors to Federal Phosphorus Company, Birmingham, Ala.—1,747,579.

Process of Manufacturing White Zinc Chloride. Jesse O. Betterton, Omaha, Neb., assignor to American Smelting & Refining Company, New York, N. Y.—1,747,751.

Refractories. Berry Marvel O'Harra, Westfield, and Edgar A. Slagle, Trenton, N. J., assignors to American Smelting & Refining Company, New York, N. Y.—1,747,905.

Manufacture of Active Silica. Fritz Stoewener, Ludwigshafen-on-the-Rhine, Germany, assignor to I. G. Farbenindustrie Aktiengesellschaft, Franfort-on-the-Main, Germany.—1,748,315.

Manufacture of Titanium-Containing Compounds. Francis George Coad Stephens, Lennox James Anderson, and William Alan Cash, London, England, assignors to National Metal & Chemical Bank, Ltd., London, England.—1,748,429.

Method of Making Di-Thiophosphates. Charles J. Romieux and Henry P. Wohnsiedler, Elizabeth, N. J., assignors to American Cyanamid Company, New York, N. Y.—1,748,619.

Ammonia Oxidizing Method. Ingenuin Hechenbleikner and Nicolay Titlestad, Charlotte, N. C., assignors to Chemical Construction Company, Charlotte, N. C.—1,748,646.

Process for Producing Sodium Sesquicarbonate. Carl Sundstrom and George N. Terziev, Syracuse, N. Y., assignors to Solvay Process Company, Solvay, N. Y.—1,748,739.

NEWS *of the Industry*

Five Hundred Papers for A.C.S. Meeting

CHEMISTRY'S advance in the South will be a dominant theme at the seventy-ninth meeting of the American Chemical Society, which will be held in Atlanta, Ga., April 7-11. More than 1,500 scientists from this and other countries are expected to attend. Five hundred papers and addresses outlining world progress in chemical science are scheduled.

The opening event will be a session of the council on Monday afternoon, April 7, when plans to meet the expanding activities of the society, now with more than 17,000 members, the largest professional organization of its kind in the world, will be discussed. The president of the society, Prof. William McPherson, of Ohio State University, will preside.

At a general meeting Tuesday morning, April 8, under the auspices of the society's division of industrial and engineering chemistry, which will usher in scores of scientific sessions, industrial chemical processes as practiced in the South will be featured.

In a public address Wednesday evening, April 9, closing a day of divisional sessions, Dr. Harrison E. Howe, of Washington, will deliver a public address on "Chemistry Comes South." Another event stressing the development of chemistry in the Southern States is a symposium on "The Relation of Cotton to Chemical Industry," to be held by the society's division of chemical education. Experts from all over the country will take part. Dr. Charles H. Herty, of New York, past president of the society, will preside.

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P. D. Schenck Addresses Members of A.S.M.E.

TAKING as his subject "Corrosion-Resistant Materials," P. D. Schenck, president of the Duriron Company, addressed the members of the A.S.M.E. in Buffalo, Feb. 25. The speaker emphasized the importance, in selecting a steel for a specific use, of seeking the advice of organizations actually familiar with not only the metallurgical side of the problem but with all the details of the chemical side of the process for which the steel is to be used. Overlooking some slight details from either the metallurgical or chemical standpoint probably will result in lamentable failures. He illustrated the point with several very interesting examples.

Concerning laboratory tests on corrosion-resistant materials, the speaker stated that there is a growing number of laboratories whose continual experience, testing equipment, and records will qualify them to make at least intelligent recommendations. His suggestion is that these laboratories be consulted and their recommendations be considered much more seriously than the reports of the plant laboratories which are now not used to this type of work and do not have the proper equipment to make tests, nor the experience to compare laboratory results with service conditions.

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American Ceramic Society Meets in Toronto

THE American Ceramic Society capped its first 32 years of existence with a most successful convention held at Toronto during the week of Feb. 16-21. The attendance was large, numbering more than 1,000 registrations. Several important actions were taken by the society, including the establishment of a new grade of membership to be known as Fellowship, attainable only after achievement which will merit the distinction in the opinion of duly constituted judges. A committee on medals and awards was established to provide a suitable award for the author of the best paper presented under each division of the society each year. Another decision involved the next meeting, which is to be held in Cleveland in 1931 in conjunction with an exposition of ceramic products similar to the one held in 1929.

Many interesting and valuable papers were presented before the seven industrial divisions. From *Chem. & Met.'s* standpoint perhaps the most interesting was the announcement by John B. Shaw, Pennsylvania State College, of a new method for producing vitrified ceramic products principally for structural and building purposes. This process involves the shaping of the clay while heated to a plastic condition, after which it is annealed.

Officers elected by the society were: Edward Orton, Jr., president; P. E. Cox, vice-president, H. B. Henderson, treasurer; and Ross C. Purdy, general secretary. New trustees elected were H. C. Kleymeyer and D. F. Albery.

American Cyanamid Buys Heller & Merz

EARLY in March two more important units were added to the rapidly growing group controlled by the American Cyanamid Company. The Heller & Merz Company, of Newark, one of the oldest of the independent dye manufacturers, was directly acquired and the Chemical Construction Company, of Charlotte, N. C., was reorganized as the Chemical Construction Corporation, in order to effect a closer working arangement with Cyanamid.

The Heller & Merz business, according to the company's announcement, is to be closely co-ordinated with that of the Cyanamid subsidiary, the Calco Chemical Company, Inc., which parallels it in organic chemical manufacturing and research. Eugene and August Merz become vice-presidents of the Calco company.

The negotiations between the officers of the Chemical Construction Company and the American Cyanamid Company have been under way since October, 1929. The new company, "Chemical Construction Corporation," resulting from the reorganization will continue the sale of the contact process of the Selden Company, another Cyanamid subsidiary, and in addition will also have available to it the developments in contact sulphuric acid made by the Calco Company. Peter S. Gilchrist will continue as president and T. C. Oliver and I. Hechenbleikner as vice-presidents.

Since the first of the year the American Cyanamid Company has acquired the Beaver Chemical Corporation, the Passaic Color Corporation and its subsidiary, the Garfield Aniline Works; the sulphate of alumina plant of the Jarecki Chemical Company, and the Superior Chemical Company.

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Monsanto Wins Phthalic Anhydride Suit

THE United States District Court at St. Louis, in a decision dated March 4, ruled against the Selden Company, of Pittsburgh, subsidiary of the American Cyanamid Company, which had charged the Monsanto Chemical Works with infringement of a patented chemical process.

The process which Selden claimed had been infringed by Monsanto Chemical refers to a converter for phthalic anhydride.

Naval Stores Conference Shows Progress

SEVERAL hundred interested members of the naval stores industries gathered in Jacksonville, Fla., on Feb. 24 for the seventh annual conference of this industry, held under the auspices of the Pine Institute of America. This conference, for the first time in the series, took on a genuine international flavor, opening with an address by the French Consul, Lucien Memminger, and frequently through the proceedings taking up international aspects of the industry's growth and development. Well qualified observers at the conference also noted a striking increase this year in the interest given to technical and scientific phases of production, grading, and marketing of rosin and turpentine.

The fundamental problems of forest permanence and the most economical handling of pine woods for naval stores production were discussed by R. Y. Stuart, Chief of the U. S. Forest Service. Major Stuart not only discussed the practical factors involved in fire and pest protection and of chipping and working of the trees but also the more fundamental studies which are being undertaken by his organization on the mechanism of gum formation in the tree.

Possibilities of co-operation of the Bureau of Chemistry and Soils in service to naval stores users were presented by Dr. Henry G. Knight, chief of that Bureau. He pointed out how investigations are indicating most effective methods for application of different types of naval stores—for example, crystallized rosin—and how quality improvement, quality control, and accurate grading are affording a sound basis in science and technology for marketing.

Some of the broad industrial economic problems of the industry were reviewed from the standpoint of science and research by Dr. C. H. Herty, who is now among the consultants of the Pine Institute. Dr. Herty emphasized particularly the necessity for complete development of the pine forests resources through production, not only of naval stores but of pulp, paper, and other wood products. He pointed out the very great importance of this type of operations, not only on naval stores themselves but also on such commodities as camphor The importance of having proper recognition given to the value of synthetic camphor, against which discrimination is often exercised, also was stressed. The part which naval stores play in the development of "The New Industrial South" formed a significant part of the inspirational address by Dr. Julius Klein, Assistant Secretary of Commerce, whose address to the conference was broadcast over a coast-to-coast radio network.

The formal resolutions adopted at the conference unanimously included a vigorous protest against "Tariff discriminations of any character against synthetic camphor, in the manufacture of which great quantities of American spirits of turpentine are now used." Another resolution includes a tariff argument worded, "We protest against the imposition of the proposed duties on imported vegetable and sea animal oils and fats, as directly and seriously inimical to the welfare of this [naval stores] industry," on the ground that "the imposition of such proposed duties on industrial oils and fats would seriously curtail the consumption in soap, varnish, and lubricating grease manufacture of the rosin produced in the Southern states without benefiting any agricultural products."

International Exposition By Belgians

LIÉGE is assuring itself of becoming a "fair" city by all standards through the ambitious congress and international exposition that will open there on May 3. Plans for the undertaking were begun as early as 1927 and have gained momentum ever since, but the approximate scope and arrangement of the affair are only now becoming discernible.

Describing itself as the International Exposition of Industry, Science, Applications, and Old Walloon Art, its primary intent is the celebration of Belgium's centenary of independence, gained in 1830. Naturally, this association has brought the exposition an official and scholastic backing that should prove an advantageous indorsement. As a result, the exhibits comprise not only a lengthy list of manufacturers but also official showplaces contributed by various foreign countries.

Concurrently with the exposition, there is being arranged a long list of congresses along all lines of human enterprise, from "chimie industrielle" and the "amis de l'efficience" down to "pomologie." Science and industry are being favored with particular care, so that while the faculties of the Liége and Brussels universities have been enlisted for leadership at all sessions, the engineering groups have the additional guidance of the various institutes and societies throughout Belgium.

The entire exposition will last from May 3 through October, and the strictly chemical engineering sessions are set for Sept. 14 to 21. Related groups also will meet in the late summer.

Westinghouse to Salute Chemical Engineer

The weekly radio salute of the Westinghouse Electric & Manufacturing Company for April 8 is to be dedicated to the chemical engineer. This program, broadcast over the red network of the National Broadcasting Company, is part of a series designed to acquaint the general public with the scientific and engineering advances taking place in the various industries and professions.

Soviet Union Will Develop Chlorine Production

THE Amtorg Trading Corporation has announced the conclusion of a contract between the United Chemical Industries of the U.S.S.R. and The Westvaco Chlorine Products, Inc., of West Virginia, providing for technical assistance in the production of liquid chlorine in the Soviet Union and the manufacture of Vorce chlorine cells for salt brine electrolysis. The contract was negotiated by Dr. P. H. Chekin, representative of the United Chemical Industries.

P. A. Bogdanov, chairman of the board of the Amtorg Trading Corporation, in announcing the signing of the new agreement, stated: "The rapid industrial development of the Soviet Union and the reorganization of agriculture necessitate the building up of a chemical industry practically from the bottom. This is particularly true of the production of chemical fertilizers, the consumption of which before the war was negligible, and which is now being nearly doubled every year. The steady growth of the textile industry, in consequence of the increased demand, particularly on the part of the village population, has brought about the necessity of establishing chlorine industries to produce the chemicals needed for bleaching of cloth."

The contract signed with the Westvaco Company provides for the use of the patents of the American company by the Soviet chemical industry and for the sending there of American engineers. In addition, Soviet engineers will study production methods at the Westvaco plants. The first chlorine plant of the several to be constructed in the U.S.S.R. is to be completed in about six months.

Cornell to Give Degree of Chemical Engineer

TO MEET the demand for men trained in chemical engineering, the Department of Chemistry at Cornell University has arranged with the College of Engineering to offer a joint curriculum leading to the degree of chemical engineer after five years of required and elective work. During four of these five years the chemical engineering students are registered in the College of Arts and Sciences, and on completion of the four-year term receive the degree of Bachelor of Chemistry. During the fifth year of residence the student will be registered in the College of Engineering and will receive the degree of Chemical Engineer upon the completion of additional work made up of lecture and laboratory courses in chemical, mechanical, and electrical engineering, supplemented by certain electives and work in machine design and chemical-plant design. The degree of Ph.D. may be obtained, as at present, by the completion of two additional years of graduate work.

NEWS FROM WASHINGTON

By Paul Wooton

Washington Correspondent of Chem. & Met.

APPROACHING its grand finale, tariff making is in a state of flux. Though the chemical rates seem to be essentially in their final form, the whole tariff issue is clouded by several important items as yet unfixed. Many a downward revision pushed through by the coalition group has been reversed as the Old Guard, reinforced through vote trading on key commodities, flattens opposition by steam-roller tactics. The coalition machine spins impotently on a greased track at this writing, with the threat that its operators will abandon straightforward measures and block the way toward the bill's passage with a filibuster.

During February, the Senate sat as a committee on the whole, passing through the entire bill. Low tariff reaction held a balance of power through the chemical schedule and beyond till it began to lose ground through the farm products and textiles, in which groups the changes were mainly upward. After March 4, when the bill was reported into the Senate, the coalition almost entirely lost control. Reserved votes for reconsideration have raised many of the chemical items back to the level set by the Senate Finance Committee.

As this is written, a re-vote remains on four major commodities: petroleum, sugar, lumber, and cement. A tariff of $1 per barrel on crude and fuel petroleum and of 50 per cent on refined products, including distillates and derivatives such as gasoline, kerosene, naptha, paraffin, etc., was upset by a 12 vote margin on Feb. 28. A rate of $2 per M ft. B.M. on certain classes of lumber is up for consideration. The sugar duty has been elevated to 2c. per pound against Cuba. Cement is slated for 6c. per 100 lb. The coalition wants sugar at 1.76c. and the other items free-listed as under existing law. Alleged vote trading between the various interests makes toward the higher rates, with probabilities even either way. After the bill is out of the Senate, there is some doubt as to what the conference committee between the House and Senate will do before final passage.

WHILE these maneuvers may affect the acceptance of the bill, no far-reaching effect on the chemical schedule is to be foreseen. Reserved votes are to come on starches, oils and fats, and hides, now on the free list, but it does not seem likely that any of these will be made dutiable. Blackstrap probably is in the same position. Its rate has been changed from ½c. per gallon to a sugar content basis almost the same. Flaxseed has taken an increase from 56c. to 65c. per bushel, where it is likely to remain.

Following are the principal tariff changes of chemical interest since the last issue: Litharge and red lead have been raised back to their present rates of 2½c. and 2¾c. per pound, respectively. Some Senators from lead-producing states had not perhaps realized that nearly 40 per cent of the nation's lead output goes into pigments. Export figures leading to the reduction were misleading in that a large share represented lead imported under bond and reexported as pigment manufactures.

An amendment has been accepted placing all fertilizer components on the free list. This changes the status of limestone, ammonium phosphate, and ammonium sulphate when used for fertilizer. The other products had been free-listed previously. This does not seem to conflict with the wishes of the trade, whose tariff contention was for a duty on mixed fertilizers, denied due to farm sentiment. The only remaining dutiable fertilizer item seems to be castor cake, which falls under a basket clause at 0.3c. per pound, a minor product which may yet be made duty free.

SOME promise of a Muscle Shoals settlement is held out during the current session of Congress with the Norris bill for government power operation and the Black amendment for private leasing of the fertilizer plants up for early consideration. It is not unlikely that the bill will pass the Senate, perhaps with some new amendment to liberalize the fertilizer concession. Under the present terms, it is hardly thought possible that any commercial firm would bid. In order to build a fertilizer and ferro-alloy industry, as advocated by local people who do not want to see the power sent into other states by utility transmission lines, an incentive greater than 8 per cent profit on fertilizer output must be offered.

What the House will do is uncertain, though there is reason to believe that a modification of the Cyanamid plan would have many supporters. At present the four House bills now pending are tied up in the Committee on Military Affairs, hampered in its progress by the death of two members and the illness of its chairman. William B. Bell, president of the American Cyanamid Company, has been explaining his offer as embodied in the Wright bill. The committee has been going over old ground in order to inform its new members as to the situation. Anyhow, the Senate action is expected to come first and to shape House legislation.

The Senate Lobby Committee has been blasting into the lobbying activities which have surrounded Muscle Shoals for the past several years. Last month, Chester H. Gray, Washington representative of the American Farm Bureau Federation, and several agents of the Tennessee River Improvement Association explained their activities on behalf of the Cyanamid offer. On March 12, Claudius H. Huston, Republican national chairman, took the stand to correct false impressions arising from his former presidency of the Improvement Association. He made the point that an electro-chemical industry is essential to the economical operation of the project.

Apparently the Cyanamid bill as such is definitely impossible of adoption, but the fact that the Black amendment was introduced in tentative form with the expressed purpose of making chemical leasing possible, some revision which will permit the Cyanamid or others to bid under the Norris-Black plan is seen as a likely solution to the long-standing Shoals controversy. Senate action is expected to follow shortly after the tariff bill is referred to committee, probably before the first of April.

A REPORT seeking to establish a "groundwork of facts" regarding Muscle Shoals has been prepared by the Water Power Policies Committee of the United States Chamber of Commerce, after a year's deliberation on general power matters. This report contains no recommendations. These are expected to follow after a final session early in April. It can be guessed from the Chamber's well-known opposition to government ownership and subsidy of private interests that the final report will not favor government action by apparent subsidy through power or otherwise which would tend to give special privileges to a successful bidder for operation of any Shoals properties. Some cost figures are included in the factual data which tend to show that profitable fertilizer production at Muscle Shoals would be difficult. A map is included which shows the nearness of several Southern cities, the inference being that power tie-ins would be readily practicable.

The membership of the special committee is as follows: Frederic A. Delano, former member of the Federal Reserve Board and railway executive; Thomas S. Baker, president, Carnegie Institute of Technology; Arthur S. Bent, president, Bent Brothers, Inc., Frank P. Glass, publisher and editor, *Montgomery Advertiser;* Lafayette Hanchett, president, Utah Power & Light Company; David C. Henny, consulting hydraulic engineer; Horace W. King, professor of hydraulic engineering, University of Michigan; Charles H. MacDowell, president, Armour Fertilizer Works; Frank I. Mann, Gilman, Ill.; Harold G. Moulton, president, Brookings Institution; R. E. Norton, vice-president C. H. Geist Securities Corporation; Lewis B. Stillwell, consulting engineer; Alexander Legge, president International Harvester Company; Harry Taylor, Major General U. S. A. Mr. Legge resigned from the committee upon being appointed chairman of the Federal Farm Board. General Taylor assisted actively in the committee work up to his recent demise.

British Rayon Industry Suffers From Overproduction

Price-Cutting Competition Has Affected Status of Small Producers

From Our London Correspondent

THE FIRST few months of this year are likely to have a depressing effect upon the chemical industry, which is not usually affected immediately by adverse trade conditions. On the other hand, cheaper money and the cutting away of dead wood are confidently expected to bring industry and employment down to the irreducible minimum from which this country appears to prefer to initiate any substantial forward movement. Even Imperial Chemical Industries has been depressed from the point of view of market valuation, in spite of the definite statement that earnings were at least as high as in the previous year. No doubt the nitrogen position is partly responsible for adverse rumors circulated by those who have not taken a sufficiently long view, but there is some foundation for anticipating reduced turnover in connection with the textile industry and in particular with the rayon business.

Courtaulds' report discloses heavy depreciation in foreign investments and a considerable reduction in earnings, and on top of this we have definite signs of overproduction, excessive competition, and price cutting, with the result that several of the smaller and more recently formed rayon concerns may go to the wall. Some of them probably are housed and situated unsuitably or are overcapitalized or technically inefficient. There probably will remain some half dozen concerns which may form themselves into one or two stronger groups and which may speak with a sufficiently united voice to make it worth while for Courtaulds and the international groups to arrive at an understanding with them. The position may be complicated by the excessive production of lower grades and the reluctance of the public to buy glossy rayon. As there are at least two rival processes in the field for the production of matt silk, the position may become exceptionally interesting at an early date.

AMONG outstanding events of the past month undoubtedly were the two addresses delivered by the president of the Society of Chemical Industry, Dr. Herbert Levinstein, on "Cellulose Fibers and Films" and on "Chemical Disarmament." Both addresses contained subject matter upon which the lay press could base a splendid "story" and particularly in regard to the address on "Chemical Disarmament," there resulted publicity to an extent which probably has never been exceeded in this country in the case of a chemical subject. In discussing cellulose fibers, Dr. Levinstein threw out the suggestion that on the basis of 8.8 kw.-hr. per kilogram, the synthetic manufacture of cellulose from carbon dioxide and water through sugar might ultimately be a commercial proposition.

The magazine of Imperial Chemical Industries for February contains some illustrations of the plant at Billingham, which, as usual in such cases, were selected as the least likely to give away any information. The most interesting one is that of the original offices of the company, now surrounded by one of the largest plants in the world and in this respect the example of one of the I.G.'s factories has been followed in preserving the original office.

THERE has been considerable activity recently in improved methods of electro-plating with particular reference to chromium plating. Here, as in America, the development of chromium plating has not been unattended by difficulty, and even now it can hardly be said that the industry is on a satisfactory theoretical or technical basis. Some recent work, particularly in connection with the use of chromium plating for dies in the engineering trade and even for matrices for gramophone records, seems to indicate that we are on the threshold of more stable and otherwise improved results, probably partly due to the more efficient and adherent deposition of the nickel underplate. Very many attempts have been made to deposit nickel or chromium on aluminum commercially, but so far without success. It is therefore interesting to note that among the other methods of protecting aluminum and aluminum alloys against corrosion by what is known as the Jirotka process, provision also is made for a special preparatory treatment prior to nickel deposition in the standard manner. The Jirotka process is now being introduced in England and has satisfactorily withstood the various preliminary tests. Aluminum can, by use of the various chemical baths and compositions for which patent protection has been applied, be colored in various ways and also protected against corrosion for normal commercial use. In addition, such preparation enables the aluminum surface to be adapted for receiving satisfactorily coatings of paint, lacquer, or nitrocellulose lacquers, which, as is known, presented many difficulties in the past, because of the formation of the usual film of aluminum oxide.

Exceptional interest was aroused by a paper read before the Institute of Fuel on "Submerged Combustion," by C. Featherstone Hammond. The underlying principle of the effective utilization of any gaseous or liquid fuel for submerged combustion is completed with intimate mixing and theoretical proportioning of combustible and air. Once this has been obtained, entirely unexpected results and efficiencies result, together with such intimate distribution of bubbles of burned gases in the liquid that transmission of heat is instantaneous. The Hammond combustion units are shown to be applicable at high efficiency, not only to central heating but also to chemical problems such as the concentration of phosphoric acid, the preparation of "stand" oil at 300 deg. C. without oxidation or charring, and the dyeing of garments at lower temperatures than are otherwise possible. Another application is that of metal melting, and in general it may be stated that the engineering design and details of construction are of a very high order.

Alundum has been used successfully for the combustion chamber lining and at temperatures varying between 700 and 1,500 deg. C. Using ordinary towns gas of 500 B.t.u. per cu.ft., and 0.4 kw. hr. per therm for boosting the gas supply and providing air at 5-lb. per square inch, the efficiency of one of these submerged combustion burners is as high as 96 per cent on the gross calorific value when applied to a central heating system and with an exhaust at 110 deg. F.

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Achema Will Celebrate Anniversary

PREPARATIONS for the Exposition of Chemical Apparatus (Achema) to be held in Frankfort, Germany, from June 10 to 22, indicate that the event is commanding especial care and interest, because it marks off the first decade since its inception. Five exhibitions have been held within that period, but as in the case of the New York show, it now recurs at greater intervals than formerly.

Meanwhile, up to February more than 200 of the German industrial equipment firms had announced exhibits, including several that represent American companies. These firms apparently constitute the best domestic chemical engineering practice, since they run from several I. G. and Krupp units to a variegated list concerned with individual processes and products. Together they now require four times the floor space used in the last exhibition (1927), a sign that a convention of this sort is highly popular in Germany so long as the intervals allow technology enough time to develop. Exhibits are arranged according to groups such as instruments and control, ceramics, applications and literature of chemistry, and large-scale industrial apparatus.

A feature of this year's exposition will be the inclusion of special exhibits, such as the one on rayon manufacture, devised by a group of leading experts, and contemporaneously there will be meetings of the leading German chemical and industrial societies.

Recovery of Coal Byproducts Gains In France

Output of Sulphate of Ammonia and Synthetic Ammonia Increased Last Year

From Our Paris Correspondent

WHILE the coke industry in France is unable to produce in sufficient quantity to take care of the country's requirements, a branch of the coke industry is making splendid progress. Recovery of coal byproducts is steadily growing, especially in the northern coal districts of France. The Bethune Coal Company, for instance, produced in 1928, 6,000 tons of sulphate of ammonia by direct carbonization and 30,000 tons of synthetic ammonia, 800 tons of ethyl alcohol, and 700 tons of methanol. In 1929, the production of methanol increased to 2,500 tons, thus increasing the output of formaldehyde, which now reaches 120 tons monthly. The low temperature carbonization is mostly done in the Noeux Vicoigne-Drocourt Coal Company works, on spherical coal agglomerates. The latter are distilled in a number of large converters adequately disposed in which super-heated steam from 600 to 650 deg. C. is insufflated at the base, the super-heating being done by multi-tubular gas chambers.

A new apparatus has been devised by the Bonnevie Company for the low-temperature distillation of lignites (French patent 588,457, Jan. 15, 1924). This apparatus has been improved since the taking of the patent and recently the inventor invited members of the technical press to witness an experiment done on a semi-industrial scale. The new apparatus consists in a vertical cylinder where horizontal cylinders with revolving paddles are internally placed, these cylinders being heated externally to a temperature of 300 to 500 deg. C. by gas. The combustible is admitted in the upper part of the apparatus by means of a hopper; it passes then from cylinder to cylinder until it reaches the lower part of the apparatus, where the semi-coke is expelled, the distilled volatile being condensed and gathered.

This new apparatus can handle 8 tons of raw matter daily and it is proposed to build as many of them as necessary near every mine shaft. The condensed products yield unrefined oils which may be immediately used by Diesel and semi-Diesel motors. In the manufacturing of carburants this new process appears to be quite as good, if not better than the one which uses carbonized or hydrolyzed chips of wood for the manufacture of alcohol and which was described in a previous letter.

Recently there has been a slump in business in all French starch factories, because of the unsatisfactory potato crops in France in 1928 and 1929, whereas the Dutch crops were excellent. In order to make up this deficiency French starch manufacturers made starch out of maize, manioc, and other grains instead of using fecula. Maize was especially used, as the import tax on it when used as raw matter for starch is extremely low. This is one of the main reasons why potato growers have pressed the state to raise the present tax on maize which is 35 fr. per quintal to 75 fr. and even 100 fr.

The French output of starch from fecula is estimated to be about 30,000-35,000 tons yearly, the number of starch factories in France being 200. The starch industry is mainly found in the eastern and northern districts. About 8,000 tons of foreign fecula starch worth 16,000,000 fr. is imported yearly. These figures are almost similar to those of prewar imports.

New Calcium Alloys Find Various Outlets in Germany

Developments in Coal Distillation Processes Also of Commercial Importance

From our Berlin Correspondent

A NEW high-temperature oven acting on the principle of surface combustion has been developed and patented by the Deutsche Gold-und Silberscheideanstalt, which overcomes the disadvantages of this type through avoidance of gas mixture before introduction into the oven and lowering of the resistance toward the incoming gases. The construction is described in *Die Chemische Fabrik*. Barrett and Wood had attained a temperature of 1,650 deg. C. with ordinary city gas and air in an oven of this type (*Chem. & Met.* 35, 179, 1928). However, in the present case, 2,400 cal. per cubic meter and a temperature up to 2,100 deg. C. can be attained with city gas. Such ovens occupying about 150 lit. of space and yielding 1,750 deg. have been put in trial for some time now.

New commercial calcium alloys, produced by the I. G., have been studied by Prof. J. Meyer, of Breslau, and are finding various uses. They are rather sensitive to air and moisture, burning, when once ignited, with the formation of a dense white smoke. For some purposes the activation of calcium by sodium is of significance. Experiments by A. von Antropoff at Bonn have proved that minute quantities of metallic sodium at the surface of calcium can incite its reaction with nitrogen. Calcium filings can be activated by precipitated sodium fumes. The same investigators likewise reports on the reaction of calcium and nitrogen in the presence of the rare gases, by which argon, for example, can be quickly and completely freed of nitrogen. The use of this process for helium, therefore, seems very suggestive.

Operating experience has taught that tri-sodium phosphate is better able to reduce boiler scale, through disposal of the deleterious agents, than most of the customary methods. Corrosion of the boilers, which usually is unavoidable, does not accompany the use of tri-sodium phosphate. In order to maintain the proper sodium-sulphate ratio in the boiler 500 times less phosphate is used than sulphate.

The new trend in liquefaction of coal discussed in the German letter for February is confirmed by the daily press, although denied officially by the I. G. The rights reserved for Germany in the contract with the Standard Oil Company can be utilized in connection with coal as well as tar and oil. The method used at any time will be determined in each case by the market conditions, it is asserted. This leaves the possibility, in any case, that tar will be used. Incidentally, a process for the production of synthetic benzol from blast-furnace gas, based on the water-gas synthesis of Fischer, has recently been put in operation near Bonn, although details are not yet available.

The Plasman coal distillation process, developed by the Chemisch-technische Gesellschaft Duisburg, also has gone into production at a new plant in Barking, near London, England. This process uses an oven with 20 horizontal, circular chambers, heated by 21 hollow cells. The oven turns with one rotation in every 4½ to 6 hours, and hence the reaction duration for each coal particle is the same. Importance is placed especially in the attainment of a hard, smokeless fuel called "Colsonite," having not more than 7.5 per cent of ash. This semi-coke drops out in large lumps and will easily find a market in London because of its firmness and freedom from smoke. An incidental advantage of the process is the production of a wholly dustless tar, due to the perfect rest of the particles during the distillation, after the mechanical pressure and expansion during plasticity have acted on them.

Tego-film is a new binder made by the Th. Goldschmidt A.G., Essen, for wood and veneers. It is a dry film impregnated with a resinous material.

MEN
in Chemical Engineering

F. W. L. TYDEMAN has been promoted from head of the Shell Petroleum Company's manufacturing department to vice-president in charge of manufacturing activities. Dr. Tydeman's career had an unusual beginning in his graduation from the North Carolina Medical College in 1912, whereupon he immediately began the practice of medicine. But in 1913, after joining the E. E. Smith Consulting Laboratories in New York, he became convinced of the possibilities of using his chemical knowledge to industrial advantage, and in 1915 joined the Shell Oil Company in California. He started as technologist at the Martinez refinery, and became assistant superintendent at Cushing, Okla., two years later. By 1920, he had become general superintendent of the Wood River (Ill.) refinery, and then went to the East Indies for several years to improve and supervise refineries there. In 1928, several years after his return, he became manager of Shell's manufacturing. Dr. Tydeman's technical efforts have been devoted to the development of topping and cracking processes.

JAMES ASTON, director of metallurgy at the Carnegie Institute of Technology, has received the award of the Robert W. Hunt Medal from the A.I.M.E. The award was made for Dr. Aston's recent process for quantity production of wrought iron, which will be exploited at a new plant being built by the A. M. Byers Company at Ambridge, Pa. The process is hoped to be of great importance in future apparatus and equipment construction.

CALENDAR

AMERICAN CHEMICAL SOCIETY, 79th meeting, Atlanta, Ga., April 7 to 11.

AMERICAN ELECTROCHEMICAL SOCIETY, spring meeting, St. Louis, May 29-31.

AMERICAN GAS ASSOCIATION, National Gas Convention, New Orleans, May 5 to 8.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Detroit, June 4-6.

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 23 to 27.

AMERICAN WELDING SOCIETY, annual meeting, New York, April 22-25.

EXPOSITION FOR CHEMICAL APPARATUS (Achema), Frankfort, Germany, June 10 to 22.

INTERNATIONAL EXPOSITION AT LIÉGE, Belgium, chemical and engineering sessions, Sept. 14 to 21.

SECOND PLENARY WORLD POWER CONFERENCE, Berlin, Germany, June 16 to 25.

WILLIAM HASTINGS BASSETT, technical superintendent and metallurgist for the American Brass Company at Waterbury, Conn., was elected president of the American Institute of Mining and Metallurgical Engineers for 1930 at its meeting in New York late in February. Five years ago this society chose him for the award of the James Douglas Medal in recognition of his "constructive research in copper and brass and other non-ferrous metals and alloys."

It was with a chemical background that Mr. Bassett came into the prominence that he has increasingly attained in his work on metals. Born in New Bedford, Mass., in 1868, he obtained his B.S. degree in chemistry from Massachusetts Institute of Technology in 1891, and thereupon became chemist for the Pope's Island Manufacturing Company. Interrupting his industrial career to teach chemistry at New Bedford for several years and returning to it by way of the New Jersey Zinc Company at Newark, N. J., he definitely allied himself with the brass industry at Torrington, Conn., in 1902. His firm at that time ultimately became a part of the American Brass Company, in which his rise brought him the position of technical superintendent in 1912.

Meanwhile Mr. Bassett's work has been associated with most of the numerous developments in the brass industry within his time. While it has concerned the mechanical and milling aspects too, it has been preponderantly exerted toward technical research and precision in methods. Mr. Bassett is a member of various societies, but on this occasion it is worthy of note that he has been in the A.I.M.E. since 1892.

LINCOLN T. WORK, of the department of chemical engineering at Columbia University, has been elected national president of the honorary chemical fraternity, Phi Lambda Upsilon.

W. E. CLIFFORD, consulting chemical engineer on wood distillation technology, has just sailed for Russia on the "Bremen" to take charge of wood distillation activities for the U.S.S.R.'s chemical trust. He will have his headquarters at Moscow. Mr. Clifford has had previous industrial experience in foreign lands, as he was once chief technologist for the Mysore government in India. In this country he has worked with the Kentucky Color & Chemical Company, Forest Products Chemical Company, and the Miner-Edgar Chemical Company.

H. C. PARMELEE, editorial director of the McGraw-Hill Publishing Company and formerly editor of *Chem. & Met.*, spoke before the Hartford Engineers Club on Feb. 20 on the subject of "Industrial New England." Dr. Parmelee recently led a group of editors on a comprehensive tour of New England.

GEORGE EASTMAN has been awarded the medal of the American Institute of Chemists "for noteworthy and outstanding service to the science of chemistry and the profession of chemists in America." The personal achievement in the building of the Eastman Kodak Company was cited in connection with the award.

A. F. PREUSTER, until recently with the Republic Carbon Company, has joined the International Graphite & Electrode Corporation at Niagara Falls, N. Y. In the industries of this district Mr. Preuster has been active for 30 years, which included a long association with the late Francis A. J. FitzGerald.

W. H. MONSSON, for seven years with the pulp and paper staff of the U. S. Forest Products Laboratory, has left to enter the research department of the Munising Paper Company, Munising, Mich.

JULES BEBIE, whose retirement from Monsanto Chemical Works was announced in the February issue, fortunately has a greater period of enjoyable living and professional service before him than the announcement indicated. He was born in 1877, and is thus really only 53 years old, of which the past 29 were spent actively in his profession.

DONALD E. CABLE has resigned his position as assistant director of research for the Oxford Paper Company to take charge of development work for the fiber products division of the U. S. Rubber Company. His headquarters are now at Cleveland.

KARL LUGER, who recently gave up his position on the Nirosta committee, has joined the American Sheet & Tin Plate Company in connection with its development of corrosion-resistant metal.

ARTHUR C. SCHULTZ, assistant chief chemist at the Bridgeville laboratory of the Vanadium Corporation of America, has resigned to assume new duties as chief chemist of the Ohio Ferro-Alloys Company at Philo, Ohio.

OBITUARY

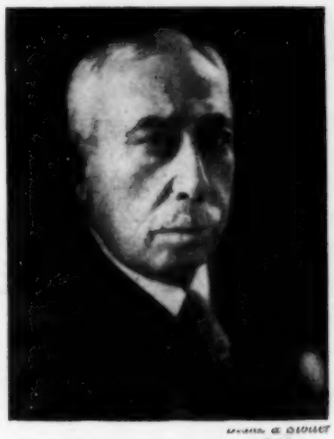
WILLIAM HENRY NICHOLS, chairman of the board of the Allied Chemical & Dye Corporation since its formation, and formerly president of several of its constituent companies, died on Feb. 21 of heart disease at a hotel in Honolulu, Hawaii. His passing deprived American chemical industry of one of its greatest figures and organizers.

Dr. Nichols was born in Brooklyn, N. Y., in 1852, and after attending school there, went to New York University until his graduation with a B.S. degree in 1870. Later that year he founded a chemical business under his father's name, G. N. Nichols & Company, and after it had proved successful incorporated it under the name Nichols Chemical Company. The General Chemical Company, which took over the chemical departments of the other concern, was founded by him in 1899, and he remained its president until 1907. The Nichols Copper Company, another outgrowth of his enterprise, enjoyed his active leadership from 1890 to 1918, when his son, William H. Nichols, Jr., became president, serving until his death in 1928. In 1907, he assumed the chairmanship of the General Chemical Company and retained it until 1920.

The formation of the Allied Chemical & Dye Corporation through the fusion of Dr. Nichols' companies, the Barrett Company, the National Aniline Company, and other firms in 1920, gave him the logical position as chairman of the board, which he filled until his death. During his career he belonged to practically every important chemical society, was a founder of the American Chemical Society in 1918, and held important posts in them. His munificence is still exemplified by his gifts to New York University and the foundation of the medal annually awarded in his name.

WALTER H. COTTINGHAM, chairman of the Sherwin-Williams Company of Canada, Ltd., and of the Sherwin-Williams Company of America, died on March 12 at his home in Maidenhead, Berkshire, England. Mr. Cottingham, who was 74 years old, retired from active business life in 1922, after having been president of the Sherwin-Williams Company since 1909.

JOKICHI TAKAMINE, JR., president of the Takamine Laboratory, Inc., Clifton, N. J., died on Feb. 22 of injuries sustained in New York. He was 41 years old, and a son of Dr. Jokichi Takamine, who first prepared adrenalin and Taka diastase, and founded the various companies here and in Japan that bear his name. On the latter's death in 1922, Mr. Takamine, Jr., who had studied at Yale, became president of the Laboratory and built it up to greater prominence in the ensuing years. Last year he was a delegate to the World Engineering Congress at Tokyo, and had returned only recently. His brother, Eben T. Takamine, now becomes head of the company.



WILLIAM H. NICHOLS

EDWARD J. LAVINO, chairman of the board of E. J. Lavino & Company, importer and dealer in minerals and chemicals, Philadelphia, died at Chestnut Hill, Pa., March 3, after an illness of nearly a year. He was 77 years old. Born in Smyrna of Dutch parents, Mr. Lavino came to the United States in 1877.

GUY STERLING, who since 1900 had carried on a private practice in general engineering with headquarters in Salt Lake City, Utah, died in that city on Feb. 23 of pneumonia at the age of 70. Following his graduation from Cornell University in 1887, he worked with the U. S. Geological Survey in California and Idaho, and from 1891 to 1899 was chief engineer of other irrigation and power projects in the West. Mr. Sterling was an inventor of a semicircular flume and patented processes for the extraction of potash from silicates and mother liquors.

CLARENCE M. FOSTER, for the past ten years Pacific Coast manager for the Barber Asphalt Company, died on Feb. 18 in San Francisco, Calif., at the age of 63.

JOSEPH H. BRAGDON, publishing director of *Textile World*, one of the McGraw-Hill publications, died suddenly of pneumonia on Feb. 19 at his home in New Rochelle, N. Y. He was only 43 years old, and had been ill for a few days following a trip. Born in Melrose, Mass., Mr. Bragdon attended school in New England, and after graduating from Yale University in 1911, he joined the textile paper founded by his father. As the head of it, he took part in the merger, in 1915, that resulted in the Bragdon, Lord & Nagle Company and ultimately in the *Textile World*. After this firm had joined the McGraw-Hill Publishing Company in 1928, Mr. Bragdon became a member of the executive committee and a director.

CHARLES TRIPLER HUTCHINSON, president of the McGraw-Hill Company of California, and publishing director of *Electrical West*, died very suddenly on Feb. 12 at Oakland, Calif., at the age of 54. He had been with the McGraw-Hill Company in the West since 1922, but had been connected with technical publications such as *Mining and Scientific Press* and *Western Engineering* since 1912. He was born in San Francisco, received his education there, and had several engineering positions in plants in that city. On the technical side, he made improvements especially on milling and crushing machinery.

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INDUSTRIAL NOTES

AUSTIN COMPANY, Cleveland, has appointed Ralph Leavenworth assistant general sales manager.

HEADLEY EMULSIFIED PRODUCTS COMPANY has announced M. D. Tracy as general sales manager.

BARTLETT-HAYWARD COMPANY, subsidiary of Koppers Company, has assumed operation of the Western Gas Construction Company.

FOOTE BROS. GEAR & MACHINE COMPANY has chosen M. E. Landry as representative at 202 Local Bldg., Oklahoma City, Okla., and Annex Equipment Company at 406 San Francisco St., El Paso, Texas.

GRISCOM-RUSSELL COMPANY is now represented in Chicago at 20 North Wacker Drive.

PERMUTIT COMPANY has promoted M. F. Corin from Philadelphia manager to general sales manager at New York.

MOELLER INSTRUMENT COMPANY is the successor to A. E. Moeller Company, Brooklyn, N. Y., although there is no change of personnel.

WAGNER ELECTRIC CORPORATION, St. Louis, Mo., has transferred P. L. Lewis from Kansas City to the home sales office in charge of merchandising.

CHICAGO BRIDGE & IRON COMPANY has bought the plant of the Reeves Brothers Company at Birmingham, Ala.

CUTLER-HAMMER, INC., Milwaukee, Wis., will henceforth have its Detroit office located at 2755 East Grand Boulevard. Its Philadelphia office is now managed by Frank J. Burd and its Cincinnati office by M. C. Steffen.

ARIZONA CHEMICAL COMPANY has been formed to exploit the salt deposits near Clarkdale, Ariz., formerly under the Sodium Products Corporation. The company will be operated by the Kalbfleisch Corporation and A. Klipstein & Company.

WELLMAN ENGINEERING COMPANY is the new name adopted by the Wellman-Seaver-Morgan Company, Cleveland, Ohio.

FOXBORO COMPANY, INC., Foxboro, Mass., has moved its Los Angeles office to 2307 East 8th St., with D. M. Hill in charge.

A. M. BYERS COMPANY, Pittsburgh, has made the following sales appointments: D. S. Sampson, at New York office, for New Jersey; R. C. Hamlett, New Orleans; I. P. Young, Chicago; T. D. Graham, St. Louis.

CHICAGO PNEUMATIC TOOL COMPANY, New York, has opened an office at 327 Philcade Building, Tulsa, Okla., under George J. Lynch.

SELDEN COMPANY, Pittsburgh, has transferred its entire sales activities to 117 Liberty St., New York, under J. M. Selden, Jr.

BRISTOL COMPANY, Waterbury, Conn., has appointed S. W. Case, manager, and W. H. Rogers, engineer, at its new office in Los Angeles, Calif.

HENDRICK MANUFACTURING COMPANY, Carbondale, Pa., has moved its Pittsburgh office to the Koppers Building.

ALSOP ENGINEERING COMPANY, New York, is transferring its quarters to 39 West 60th St.

REEVES PULLEY COMPANY, Columbus, Ind., has opened a Cleveland office at 5005 Euclid Ave., under D. C. Batterson.

MORBY & JONES, LTD., is the new corporate name of Morey, Jones & Lovell, Inc., Los Angeles, Calif.

AMERICAN ASPHALT PAINT COMPANY, Chicago, has opened a New York City office at 393 Seventh Ave.

ROLLER-SMITH COMPANY, New York, has appointed Henry N. Muller, district agent, with headquarters at First National Bank Building, Pittsburgh, Pa.

WAUKEGAN CHEMICAL COMPANY, North Chicago, Ill., has changed its name to Brevolite Lacquer Company, as more descriptive of its products.

ECONOMIC INFLUENCES
on production and consumption of CHEMICALS

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Domestic Chemical Output Exceeds Current Consuming Demands

Accumulated Stocks Develop Selling Pressure and Unstable Prices

WHILE a check upon manufacturing operations has gone into effect in different branches of the chemical industry, production so far this year has been relatively high. Consuming industries in most cases have not operated as actively as was the case a year ago and have not absorbed chemical products as fast as they were produced. Hence there has been a gain in unsold stocks since the first of the year. In many instances this has encouraged more strenuous selling methods and price-cutting has been resorted to in an endeavor to stimulate the buying movement.

From figures now available it is evident that the slump in general industry which was experienced in the latter part of last year, affected consumption of chemicals in a marked degree in December. Since then there has been a recovery, but disappearance of chemicals so far this year has fallen below the level maintained a year ago. As far as the immediate future is concerned, much depends upon the building and automotive industries.

THE position of some of the producing and consuming branches of the chemical industry is fairly well defined by statistics covering operations in January. The following data offer some comparisons with January, 1929:

	Jan., 1930	Jan., 1929
Consumption		
Cotton, bales	577,235	668,286
Wool, 1,000 lb.	43,627	54,031
Silk, bales	57,683	57,349
Fertilizer, in South, ton	504,440	452,490
Production		
Arsenic, crude, ton	1,079	1,136
Refined, ton	742	913
Acetate of lime, 1,000 lb.	11,798	11,996
Methanol, crude, gal.	715,886	700,613
Refined, gal.	248,723	494,501
Ethyl alcohol, 1,000 gal.	11,601	15,282
Rosin, wood, bbl.	40,954	37,765
Turpentine, wood, bbl.	7,510	7,347
Pine oil, gal.	254,894	238,703
Automobiles, cars, number	234,527	347,382
Taxis, number	572	2,064
Trucks, number	37,990	51,591
Pneumatic tires, 1,000	3,611	5,042
Plate glass, 1,000 sq. ft.	10,018	11,426
Byproduct coke, 1,000 ton	4,203	4,360

These comparisons indicate a decline in consumption of chemicals in the textile, glass, and rubber industries. Not much change is indicated in production of wood-distillation chemicals. The drop in output of automobiles undoubtedly has had an adverse effect on the movement of many chemicals. Shipments of linseed oil from crushing centers have fallen far below the totals for the corresponding period of 1929, and this is a fair index of the position of paint and varnish manufacturers.

On the other hand, producers report a steady movement of alkalis into consumption, with total deliveries very close to last year's figures. Fertilizer chemicals have moved freely and, while a temporary setback was encountered in the drop in value for cotton, the prospects favor a large consumption of fertilizer in the southern states this season.

Insecticides and fungicides face an encouraging outlook. The use of these materials has been forced by the growth in the number and variety of pests. The fact that the people have been educated to realize the value of chemical treatment to check, if not to prevent, pest damage is a decided factor in the development of the insecticide industry.

FOREIGN exchange in some countries has worked into a position where it is not favorable for the export trade of this country. The decline in monetary values abroad reduces the purchasing power of foreign money in our markets. Considering conditions in outside countries the outward movement of chemicals and related products in January was very creditable. Total value of exports for that month was $11,495,223, as compared with $12,455,523 for January, 1929. With a lower average price level this year the comparison of exports undoubtedly would be more favorable if it could be made on a basis of quantity instead of value.

The coal-tar group made an excellent showing in the export trade for January, the value of such shipments exceeding that for the group in the corresponding month of last year. Benzol and coal-tar pitch were especially prominent in the export trade this month with a marked decline in the overseas movement of crude coal-tar and coal-tar colors.

Medicinal and pharmaceutical preparations, likewise, registered gains this year. Industrial chemical specialities moved up slightly in the value column, with no single selection standing out in any way.

The industrial chemical group was reported at a value of $2,155,718 for January this year as against $2,235,297 for January, 1929. A considerable decline was experienced in foreign demand for acids and anhydrides. Smaller amounts of aluminum sulphate were shipped out this year. Acetate of lime dropped out as an export commodity. The sodium compounds ranked high in the January shipments, the totals being 52,024,876 lb. this year and 48,029,028 lb. last year. Borax, silicate of soda, soda ash, and caustic soda were responsible for the increase, all of them improving their position in the relative periods.

IMPORTS of chemicals in January were valued at $13,788,104, as compared with $12,517,836 for January, 1929. The coal-tar group fell off nearly 25 per cent, with creosote oil, intermediates, and dyes contributing to the decline. Industrial chemicals forged slightly ahead of last year, with notable increases in the arrival of arsenic, acetic acid, magnesium compounds, potassium carbonate, argols, and potassium chlorate and perchlorate. Only small lots of glycerine figured in the import trade this year.

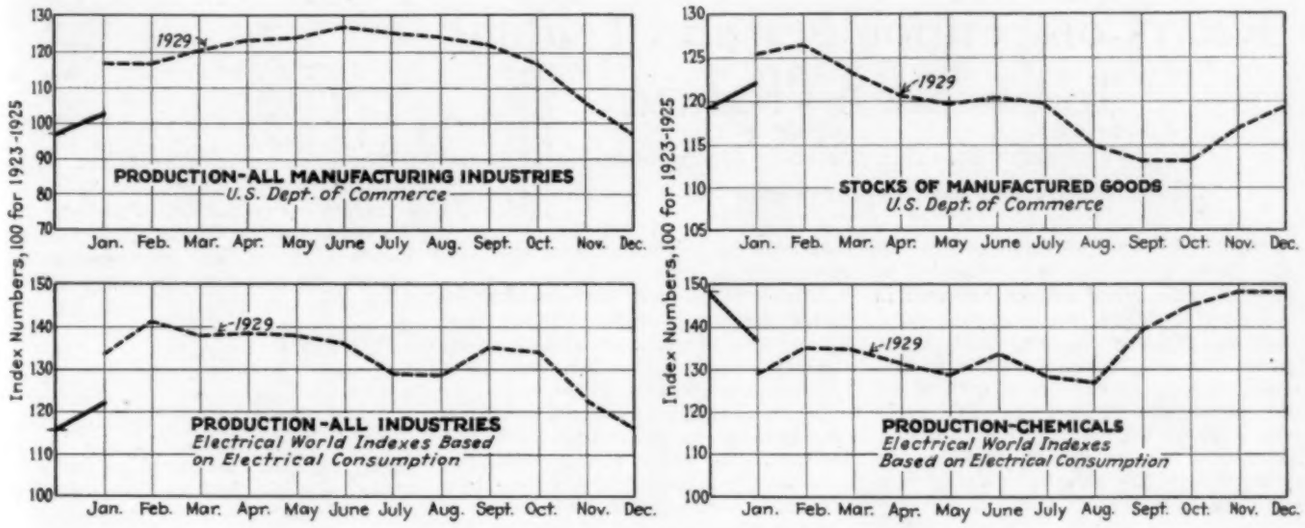
The inward movement of fertilizers and fertilizer materials this year represented an increase of more than 27 per cent in value and nearly 17 per cent in volume, over the totals for January, last year. The potash salts were the most important factors in the increase, whereas receipts of sulphate of ammonia declined from 3.349 tons to 432 tons.

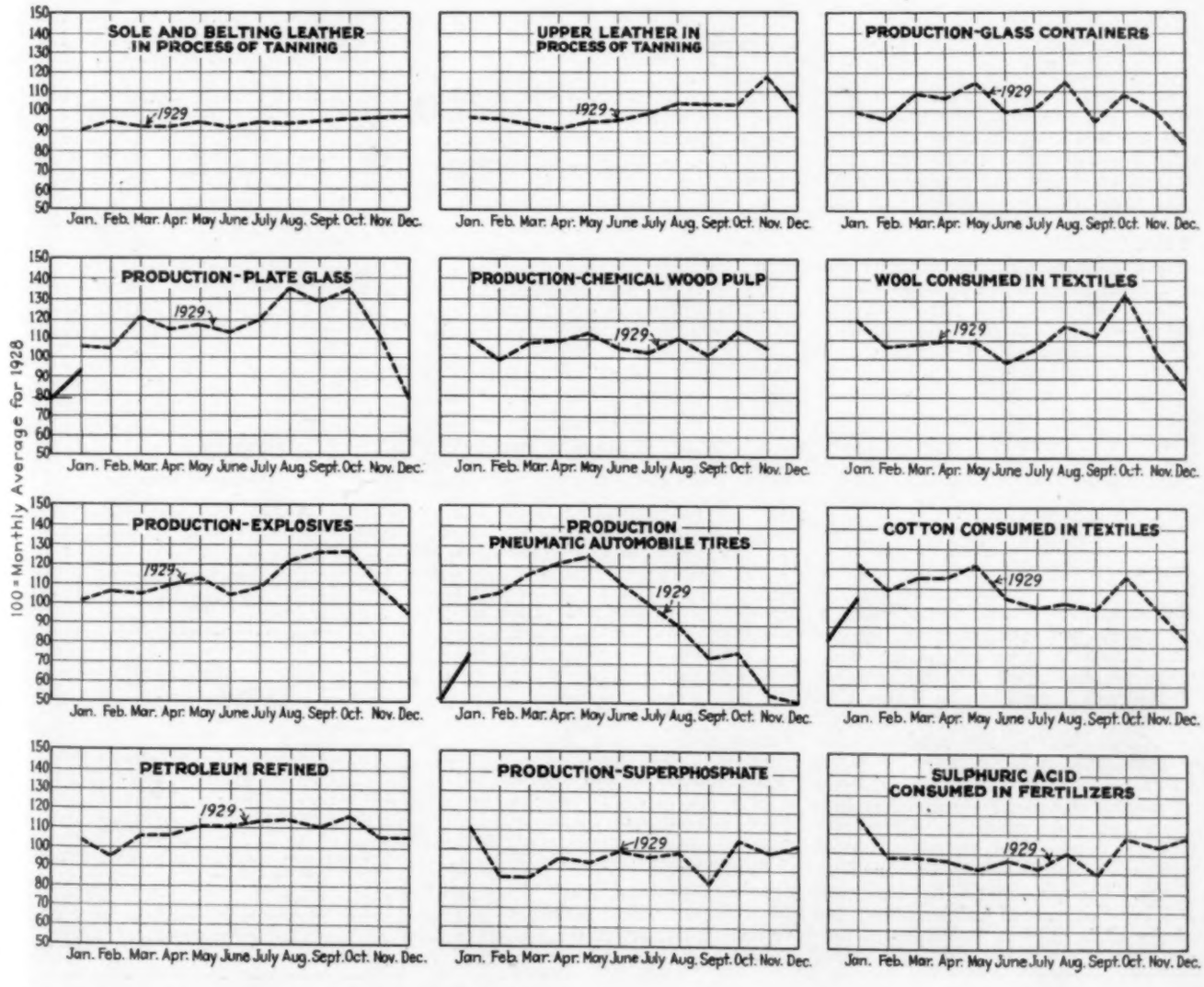
INDUSTRIAL output during January after adjustments for seasonal variations, showed a gain over the preceding month but was lower than a year ago, according to the weighted index of the Federal Reserve Board. Manufacturing production likewise was greater in January than in December, but was lower than in January, 1929. The production of minerals showed declines in January from both the previous month and the same month of last year.

The general index of commodity stocks at the end of January was greater than a year ago, the increase over last year being solely due to larger holdings of raw materials. Manufactured goods in the hands of manufacturers were held in smaller quantities at the end of January than at the end of the same month of the preceding year.

Unfilled orders for manufactured goods at the end of January showed gains over both the preceding month and January, 1929. As compared with the previous month, all groups for which data were available showed larger orders.

ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES


PRODUCTION-ALL MANUFACTURING INDUSTRIES
U.S. Dept. of Commerce
STOCKS OF MANUFACTURED GOODS
U.S. Dept. of Commerce
PRODUCTION-ALL INDUSTRIES
Electrical World Indexes Based on Electrical Consumption
PRODUCTION-CHEMICALS
Electrical World Indexes Based on Electrical Consumption
Index Numbers, 100 for 1923-1925
1929
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.


SOLE AND BELTING LEATHER IN PROCESS OF TANNING
UPPER LEATHER IN PROCESS OF TANNING
PRODUCTION-GLASS CONTAINERS
PRODUCTION-PLATE GLASS
PRODUCTION-CHEMICAL WOOD PULP
WOOL CONSUMED IN TEXTILES
PRODUCTION-EXPLOSIVES
PRODUCTION PNEUMATIC AUTOMOBILE TIRES
COTTON CONSUMED IN TEXTILES
PETROLEUM REFINED
PRODUCTION-SUPERPHOSPHATE
SULPHURIC ACID CONSUMED IN FERTILIZERS
100 = Monthly Average for 1928
1929
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

MARKET CONDITIONS *and* PRICE TRENDS

Keen Competition Features Trading In Chemical Products

Producers More Aggressive in Attempts to Move Surplus Stocks

CONSUMING demand for chemicals last month was continued on a scale below that experienced in the corresponding period of last year, and the effect of this was seen in the prevalence of a buyers' market with concessions from quoted prices granted on the majority of commodities. Producers were competing keenly for business, either to reduce surplus stocks or to place new orders on their books against future production.

Trading in acetate of soda was of especial interest, because of the presence on the market of round lots which were said to have been produced outside the ordinary channels. Sales to consumers were reported as low as 3c. per pound and dealers are said to have picked up distress lots at even lower figures. The competition thus offered has affected production on the part of regular manufacturers as the prices quoted are considerably below ordinary producing costs.

PRODUCTION, shipments, and exports of sulphur reached new high levels in 1929, according to the U. S. Bureau of Mines. Sulphur production amounted to 2,362,389 long tons in 1929, compared with 1,981,873 tons in 1928, and 2,111,618 tons in 1927, the previous record year. Shipments totaled 2,437,238 tons, valued at about $43,800,000, compared with 2,082,924 tons, valued at about $37,500,000, in 1928, the previous record year.

In 1929 production was continued as in previous years in Texas, at Gulf, by the Texas Gulf Sulphur Company; at Bryan and Hoskins Mounds, Freeport, by the Freeport Sulphur Company; at Benavides, by Duval Texas Sulphur Company, and at Wharton, by the Union Sulphur Company. A new operation on Boling Dome, at Newgulf, Texas, was started by the Texas Gulf Sulphur Company during the latter part of March, 1929. No production or shipments of sulphur were made in Louisiana in 1929. The final shipments of sulphur from the stockpile at Sulphur, La., were made in 1928. Over 99.9 per cent of the country's production and shipments of sulphur came from Texas. The properties of the Humboldt Sulphur Company at Sulphur, Nev., and of the Utah Sulphur Industries at Sulphurdale, Utah, were the only others that reported production and shipments of sulphur in 1929.

Stocks of sulphur on hand at the mines decreased nearly 100,000 tons, following a decrease of approximately 100,000 tons in 1928, and were about 1,900,000 tons on Dec. 31.

Carbon gas black offers another instance of prices weakened by selling pressure. The output of this commodity was greatly increased last year. This resulted not only because of active demand in the early part of the year but also because in some producing sections it was feared that legislation would restrict the amount of natural gas for carbon black manufacture. In order to forestall any scarcity of the raw material, producers increased their rate of operations and were willing to accumulate large surplus stocks as a protection against possible reduced outputs later on. As a matter of fact, no measures against the use of natural gas for carbon black production were taken. In the latter part of the year, tire manufacturers and other large consumers cut down consumption of carbon black and the new year found producers carrying large supplies with a falling off in demand confronting them. Soon weaker holders began to cut prices and this extended throughout the industry. At present demand is less than it was a year ago and keen competition continues. As a new factor, a proposal has been made in Texas to place a tax of one-fourth cent per pound on all carbon black produced in that state.

IN the market for vegetable oils, the most important development is that a new basic trading grade for cottonseed oil futures on the New York Produce Exchange has just been announced by the Hoover arbitration committee. In this award the grade is defined as a "bleachable prime yellow refined cottonseed oil, to bleach not deeper than 20 yellow and 2.5 red according to the reading of the Luvibond scale." The new grade does not go into effect immediately, due to the rules of the Produce Exchange, which require its posting for a specified number of days.

In its original award the committee, appointed two and a half years ago by Mr. Hoover when Secretary of Commerce, to decide on the trading grade for cottonseed oil and to revise the rules of the New York Produce Exchange, defined the oil as "a once-refined untreated oil." This definition lent itself to so many interpretations that the cotton oil section of the exchange refused the award in that particular and noted an appeal.

The adoption of a grade of "prime summer yellow refined cottonseed oil to bleach not deeper than 25 yellow and 3.5 red according to the reading of the Luvibond scale" was requested in the appeal. In a counter argument said to have been advanced by Texas interests the grade finally adopted by the committee was proposed.

Refiners allege that the 2.5 red requirement will work great hardship to producers in the Mississippi valley and the Southeast, particularly in wet years, and give the advantage to Texas crude mills, the bulk of whose production will meet the new requirement.

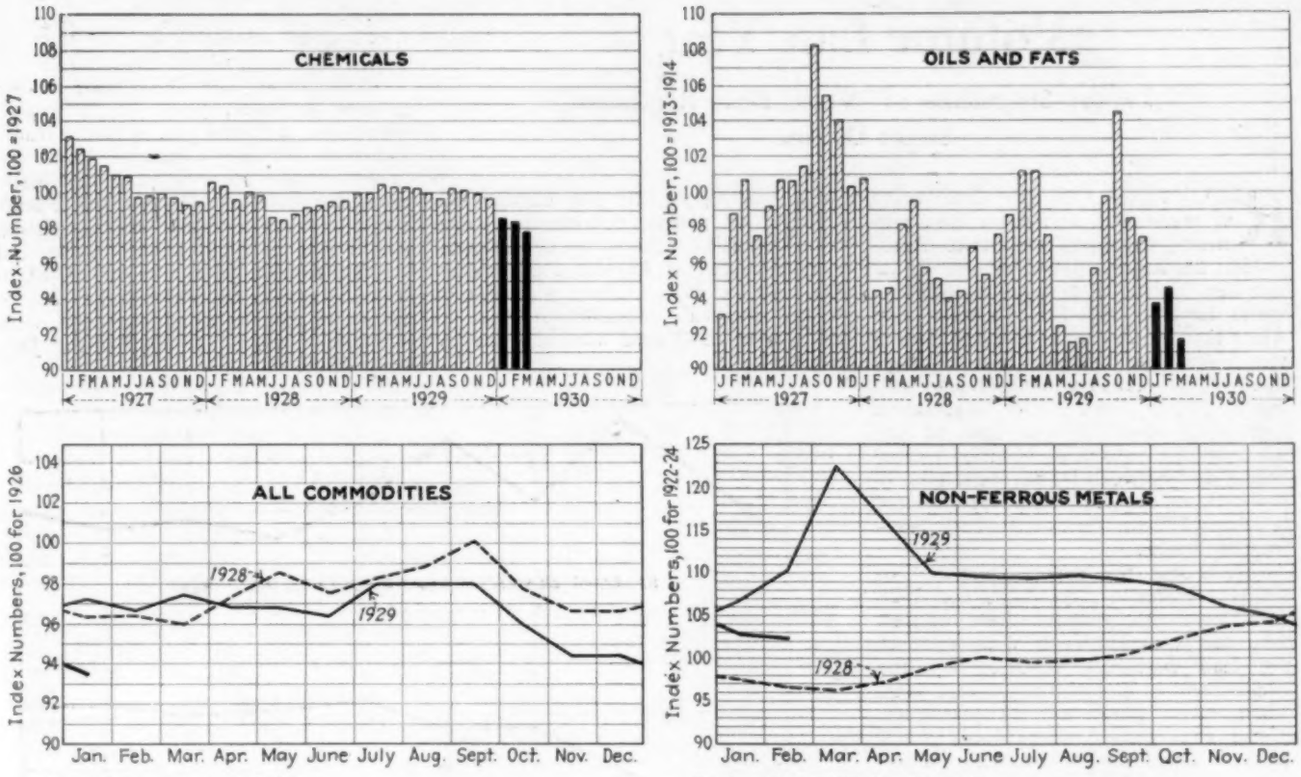
Exports of Chemicals

	Jan. 1930	Jan. 1929
Benzol, gal.	2,907,554	1,700,580
Crude coal-tar, bbl.	5,201	9,453
Coal-tar intermediates, lb.	422,508	387,416
Coal-tar dyes, lb.	2,025,199	2,865,800
Lead, arsenate, lb.	125,705	140,194
Acid, sulphuric, lb.	882,315	429,264
Acid boric, lb.	226,953	326,221
Methanol, gal.	47,571	27,115
Glycerine, lb.	38,025	119,662
Acetone, lb.	229,406	659,291
Formaldehyde, lb.	172,792	230,919
Ammonium compounds, lb.	228,283	140,395
Aluminum sulphate, lb.	4,610,196	4,964,915
Acetate of lime, lb.	.....	42,313
Calcium carbide, lb.	435,451	414,183
Bleaching powder, lb.	716,848	787,736
Calcium chloride, lb.	1,068,282	656,019
Copper sulphate, lb.	768,924	865,929
Potassium compounds, lb.	138,831	365,369
Sodium bichromate, lb.	431,994	896,611
Sodium cyanide, lb.	69,220	82,061
Borax, lb.	18,336,539	10,982,926
Sodium silicate, lb.	5,227,193	4,210,842
Soda ash, lb.	6,146,899	4,706,869
Sodium bicarbonate, lb.	1,465,690	1,920,778
Sodium sulphate, lb.	98,143	208,386
Modified sodas, lb.	1,633,120	1,044,423
Caustic soda, lb.	11,167,432	10,202,954
Ammonia anhydrous, lb.	340,401	321,156
Chlorine, lb.	322,897	443,162
Sulphate of ammonia, ton.	10,628	10,395
Sulphur, ton.	59,086	66,701

Imports of Chemicals

	Jan. 1930	Jan. 1929
Dead or creosote oil, gal.	8,187,903	10,751,284
Pyridine, lb.	.....	17,357
Coal-tar acids, lb.	50	57,295
Coal-tar intermediates, lb.	156,967	146,745
Coal-tar dyes, lb.	441,222	551,275
Arsenic, lb.	2,107,023	1,374,263
Acid, formic, lb.	39,200	137,900
Acid, oxalic, lb.	66,917	58,262
Acid, sulphuric, lb.	60,200	1,087,259
Acid, tartaric, lb.	400,736	28,000
Acid, acetic, lb.	3,504,804	2,982,085
Ammonium chloride, lb.	394,436	738,561
Ammonium nitrate, lb.	571,802	508,883
Barium compounds, lb.	751,726	1,069,588
Calcium carbide, lb.	315,520	300,300
Cobalt oxide, lb.	35,585	43,498
Copper sulphate, lb.	410,556	199,027
Bleaching powder, lb.	269,649	307,433
Magnesium compounds, lb.	1,884,882	1,664,908
Iodine, crude, lb.	43,435	64,437
Glycerine crude, lb.	189,142	1,054,595
Potassium cyanide, lb.	16,358	.....
Potassium carbonate, lb.	2,317,716	1,835,315
Caustic potash, lb.	1,226,871	1,148,277
Cream of tartar, lb.	.....	11,200
Potassium chlorate, lb.	1,837,280	745,232
Sodium cyanide, lb.	2,653,726	3,149,320
Sodium ferrocyanide, lb.	142,425	204,748
Sodium nitrite, lb.	110	11,499
Sodium nitrate, ton.	89,421	83,698
Sulphate of ammonia, ton.	432	3,349

CHEM. & MET. *Weighted Indexes of* PRICES


CHEMICALS
Index Number, 100 = 1927
OILS AND FATS
Index Number, 100 = 1913-1914
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1927
1928
1929
1930
ALL COMMODITIES
Index Numbers, 100 for 1926
1928
1929
NON-FERROUS METALS
Index Numbers, 100 for 1922-24
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

U. S. Department of Labor. *Engineering & Mining Journal.*

Lower Price Trend Underlies Market for Chemicals

THE weighted index number for chemicals was lowered during the past month. In part, this followed as a result of reductions in production costs. To a greater extent it was due to a preponderance of supply over demand, with consequent pressure on the market. The buying movement was not so active as had been anticipated and producers appeared to be reluctant to hold outputs to a point commensurate with the volume of buying. The market, therefore, has favored buyers and price concessions were obtainable on a wide selection of chemicals. While a more extended view holds out considerable promise, the immediate outlook points to a continuance of an easy price tone.

Among the materials for which price recessions were logical, based on the raw material position, mention may be made of the lead and tin salts. Overproduction of lead is demonstrated by current statistics, and the condition is world wide, so that it is not easily rectified. Hence a near-by recovery in values for that metal is not probable. Tin is in a position similar to that reported for lead.

Denatured alcohol is passing through a quiet period and quoted prices are not being maintained. The weakness in values appears to be purely a matter of selling pressure with conditions warranting a strong market should a revival of buying set in.

Deliveries of mixed fertilizers in Southern states have gone forward in large volume and very encouraging reports were heard regarding the probable movement of fertilizer materials until the break in cotton values, when less favorable reports came into existence. However, the National Fertilizer Association reports that fertilizer sales during February amounted to 1,118,649 tons, as compared with 866,317 tons for February of last year.

A general survey of the chemical market brings out the fact that the movement into consumption is of large volume, but it is below the standards established last year. With a reduced buying interest, the market has developed keener competition on the part of sellers. Selling pressure is probable as long as this condition maintains. Future prices, therefore, may be gaged on the individual interpretation of how quickly general business conditions will return to the levels current last year.

VEGETABLE oils have shown a declining price trend during the period, with lower quotations applying to practically every selection. Supplies are ample and buyers have restricted operations so that the burden of moving stocks has rested on sellers. No immediate change is forecast, but seasonal conditions should increase activity before long and present price levels appear to be on bottom or at least very close to it. The low prices recently quoted for tallow have resulted in the disposition of large amounts, with buyers evidently having confidence in the price level.

Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

This month	**97.90**
Last month	98.32
March, 1929	100.50
March, 1928	99.62

A quiet buying movement weakened values throughout the chemical market in general and, while open reductions were not numerous, buyers were able to secure price concessions. Sulphate of ammonia, tin salts, lead oxides, and different solvents were included among the items for which lower prices prevailed.

Chem. & Met. Weighted Index of Prices for Oils and Fats

Base = 100 for 1927

This month	**91.79**
Last month	94.68
March, 1929	101.11
March, 1928	94.63

Practically all of the vegetable oils sold off in price during the month. Crude cottonseed and China wood oils had the greatest influence in depressing the weighted index number. Palm oil held fairly steady. Tallow declined appreciably.

Sales of Lead Pigments Gained in Volume Last Year

Export Shipments of White Lead Registered Slight Decline

REPORTING ON the distribution of white lead and other lead pigments, the Lead Industries Association announces that shipments by its members during 1929 were as follows: white lead in oil, 115,345 tons; dry white lead, 45,204 tons; litharge, 84,873 tons; red lead, 42,880 tons; orange mineral, 491 tons; and basic lead sulphate 17,065 tons. The association represents about 98 per cent of the white-lead production of the United States and between 90 per cent and 95 per cent of the lead oxide production. It covers 100 per cent of the basic lead-sulphate business.

Continuing, the report states: "No similar figures are available for 1928 with which to compare these figures. The best comparison is with sales of the lead pigments reported by the Department of Commerce for that year, which cover practically all producers. These figures are: white lead in oil, 111,923 tons; dry white lead, 42,049 tons; litharge 85,570 tons; red lead, 40,497 tons; orange mineral, 459 tons; and basic lead sulphate, 16,368 tons.

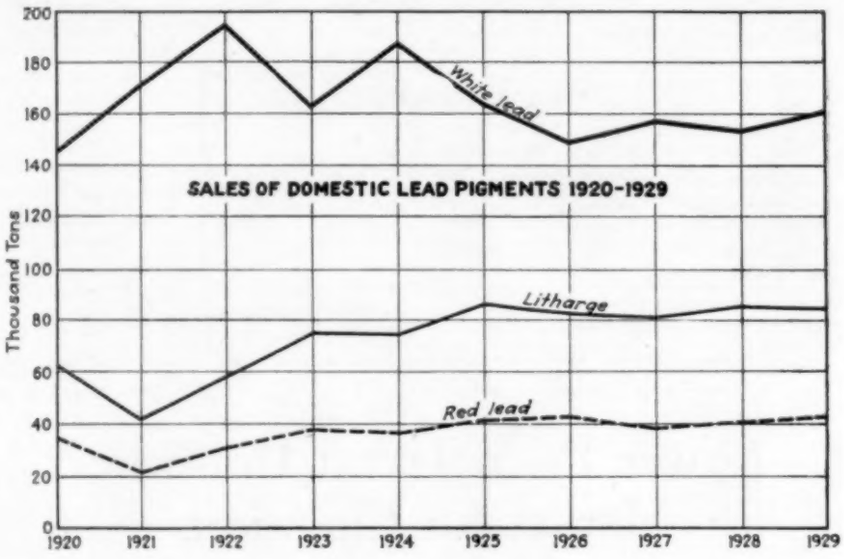
"The principal use of white lead is as a pigment in high-grade paints. It is also used in glazing pottery and enameled ware, and in putty. Litharge is used in the manufacture of storage batteries, paint, enameled ware, linoleum, glass, pottery, varnish and rubber, and in oil refining. Red lead, as well as being used in most of the industries using litharge, is also the standard protective paint for structural steel. Orange mineral is largely used in paints and printing ink, while basic lead sulphate's principal use is in paint."

SALES of domestic lead pigments are reported annually by the U. S. Bureau of Mines. Comparison of the movement into consumption for the last 10 years shows the following:

Sales of Domestic Lead Pigments

	White Lead Tons	Litharge Tons	Red Lead Tons
1920	145,695	62,329	34,431
1921	170,283	41,909	21,805
1922	194,991	58,261	30,509
1923	162,873	75,107	38,037
1924	187,494	74,724	36,813
1925	163,905	86,546	41,669
1926	149,813	82,540	42,550
1927	157,695	81,655	39,073
1928	153,972	85,570	40,497
1929	160,549	84,873	42,880

In the above table, the figures for 1929 are those given by the Lead Industries Association, the totals for white lead in oil and for dry white lead being combined, but not including basic lead sulphate. No consideration has been given, in the above comparison, to orange mineral, because the tonnage is small and very little net change has occurred in annual consumption since 1914. In 1914, sales of orange mineral were reported at 426 tons, as against 491 tons for 1929. The high point of orange mineral consumption was in 1925, when 840 tons was shipped by producers.



The increase in domestic consumption of lead pigments since pre-war years does not show the expansion which the growth of consuming industries would warrant. In 1914, consumption of white lead was reported at 159,474 tons, which is very close to the total consumed last year. Litharge, because of its more widely diversified use, has responded more actively to the general growth of domestic industry. In 1914, sales of litharge amounted to 27,345 tons in comparison with 84,873 tons in 1929.

White lead has lost considerable ground in recent years in its importance as a factor in export trade. Whereas foreign countries have increased orders for zinc oxide and lithopone, the reverse is true for white lead. Export trends for these three pigments are shown in the following table and for the present year, exports of white lead in January amounted to 730,220 lb. valued at $59,556 which compares with 420,305 lb. valued at $30,709 for January, 1929.

	White Lead Lb.	Zinc Oxide Lb.	Lithopone Lb.
1920	34,441,918	30,925,243	.....
1921	17,408,803	10,149,360	.....
1922	8,945,730	6,726,285	3,231,722
1923	10,344,089	10,047,408	2,970,743
1924	10,109,455	7,854,394	1,845,073
1925	13,663,309	21,710,048	2,573,354
1926	12,478,333	29,322,592	3,881,329
1927	12,094,514	28,988,818	4,220,132
1928	12,952,743	29,598,165	6,651,523
1929	11,815,479	35,273,134	9,112,040

Industrial Consumption of Turpentine and Rosin

INDUSTRIAL concerns using turpentine and rosin in their products consumed during 1928 a total of 5,304,099 gal. of turpentine and 947,387 bbl. of rosin, according to figures compiled by the U. S. Department of Agriculture. Data compiled incident to the investigational work of the bureau on uses of naval stores show the following distribution of consumption of these materials by manufacturing industries for the years 1928, 1927, and 1926.

	Turpentine Gal.			Rosin round 500-Lb. Bbl.		
	1928	1927	1926	1928	1927	1926
Paper and paper size	4,231	3,651	6,956	333,942	297,426	325,312
Soap	1,599	1,575	5,373	182,538	200,454	236,514
Paint and varnish	4,306,483	4,701,166	4,428,447	245,157	228,776	219,530
Shoe polish	561,116	599,669	534,079	635	905	1,078
Printing ink	10,131	15,060	12,572	14,815	14,553	14,161
Oils and greases	42,969	113,407	180,871	48,609	56,613	57,752
Sealing wax, pitch, insulations, and plastics	68,248	59,234	66,291	34,537	38,674	51,500
Matches	250	.....	.....	2,810	2,965	2,815
Linoleum	2,312	3,250	5,524	58,204	37,586	44,357
Chemicals and pharmaceuticals	55,235	24,205	29,061	3,709	8,462	5,201
Automobiles and wagons	158,901	242,022	280,585	1,214	1,029	907
Foundries and foundry supplies	15,001	21,684	16,179	18,558	16,907	21,052
Shipyards, car shops, etc	41,315	15,847	16,042	104	90	102
Miscellaneous	36,308	37,528	35,069	2,555	2,511	3,804
Totals	5,304,099	5,838,298	5,617,049	947,387	906,951	984,085

MARKET APPRAISAL OF CHEMICAL INDUSTRY

National Lead Company of California has acquired the business and assets of the Bass-Hueter Paint Company. Sales forces of the two companies will be consolidated under National Lead Company of California. No announcement as to terms of acquisition was made.

•

The Dow Chemical Company, through Cleveland and Detroit financial houses, is offering $3,500,000 10-year, 6 per cent sinking-fund notes. Proceeds will be used for expansion of productive facilities.

•

It is rumored that Liquid Carbonic Corporation's additional 31,334 shares of common, for which listing application has been filed with the New York Stock Exchange, will be used for purpose of acquiring new companies.

•

American Solvents & Chemical Corporation stock totaling 110,939 shares of $3 cumulative convertible preferred of no par value and 169,553 shares of common have been listed by the New York Stock Exchange.

•

The Goodyear Tire & Rubber Company has announced that a proposed plan whereby the capital stock of the company will be increased from 1,450,000 shares to 5,000,000 will be presented to the stockholders at the annual meeting on March 31.

•

A new offering of 12,000 shares of common stock of J. T. Baker Chemical Company is being offered by a New York financial organization. The stock is being offered at $20 per share.

•

The first annual meeting of the stockholders of the Union Solvents Corporation was held on Feb. 26. The president of the corporation, Jule P. Carter, reported that the plant at Cincinnati, Ohio, has been completely equipped with new machinery and other equipment and the improvements are finished. Test runs were made beginning Jan. 20. The company is now ready to manufacture and deliver normal butyl alcohol and chemically pure acetone.

•

Financial reports for the year ended Dec. 31, 1929, have been issued by many companies in the chemical and related industries. Net profits as shown by some of these companies are given below, with comparisons for 1928:

	1929	1928
Air Reduction	$5,972,995	$3,208,993
Am. Commercial Alcohol	1,395,716	.....
American Metal	3,252,879	2,651,933
Am. Solvents & Chemical	800,627	670,708
Atlas Powder	2,542,692	*5,839,664
Baker Chemical, J. T.	235,790	197,894
Beechnut Packing	2,702,953	2,768,768
Bon Ami	1,455,211	1,283,860
Celanese Corp.	2,952,321	2,356,976
Commercial Solvents	3,367,402	2,929,420
Congoleum-Nairn	2,213,830	1,462,046
Corn Products	16,309,651	13,192,974
Devoe & Raynolds†	1,085,615	1,079,573
Du Pont	78,171,730	64,097,797
Eagle-Picher Lead	1,215,812	1,151,178
Freeport Texas†	4,085,041	3,275,576
Gold Dust	7,586,963	2,731,769
Hercules Powder	4,358,904	4,038,980
International Salt	687,767	439,595
Lehn & Fink	1,721,608	1,906,269
Mathieson Alkali	2,324,276	2,091,402
Monsanto Chemical	1,691,338	944,438
National Distillers	609,389	585,105
National Lead	10,222,897	5,872,496
New Jersey Zinc	9,221,794	7,433,545
Newport Company	1,682,285	585,426
Pratt & Lambert	1,251,587	1,432,924
Texas Gulf Sulphur	16,247,478	14,517,619
Westvaco Chlorine	1,127,054	845,718

*Includes $4,151,000 profit from sale of Canadian Industries, Ltd. †Year ended Nov. 30.

Price Range 1930 High	Price Range 1930 Low	Stock	Price Feb. 1	Price Range in February High	Price Range in February Low	Price Feb. 28
134	118	Air Reduction	125½	134	122½	133
2½	1½	Ajax Rubber	2	2½	1½	2
282	225½	Allied Chemical	281	282	265½	267
7½	6	Am. Ag. Chemical	....	7½	6	7½
29½	25½	American Cyanamid, B	29½	29½	25½	25½
5½	4½	American Hide and Leather	4½	5½	4½	....
51½	44	American Metals	46½	51½	45½	47½
16½	10	Am. Solvents and Chemical	....	16½	11	16
21	15½	Anglo-Chile Nitrate	19	19½	18	....
27½	23½	Archer-Daniels-Midland	25½	26½	23½	24½
6½	5½	Armour Ill. A	5½	6½	5½	5½
3½	2	Assoc. Dyeing and Printing	2½	3½	2½	3
94	81½	Atlas Powder	....	94	83½	90½
16½	13	Beacon Oil	....	15½	13	14½
70½	60½	Beechnut Packing	....	68½	63	64
72	70½	Bon Ami, A	71½	71½	71	....
28	28	California Petroleum	....	28	28	....
35	24	Celanese	31	31	24	24
15½	11	Certainteed	14	15½	13	13½
28½	25	Chickasha Cotton Oil	....	28½	26½	....
60½	52	Colgate-Palmolive-Peet	52½	60½	52½	60½
32½	27½	Commercial Solvents	28½	32½	28½	31½
99½	87½	Corn Products	99½	99½	91½	95
40	28½	Davison Chemical	33½	40	33½	38
42½	30½	Devoe & Raynolds	34½	42½	33½	41½
131	112½	DuPont	128½	131	121½	127½
117½	114½	DuPont, 6 p.c. deb	....	116½	114½	....
221½	175½	Eastman Kodak	195	221½	189½	216½
33½	26	Firestone Tire	29½	....	....	27
4½	3	Fisk Rubber	4	4	3½	3½
44	38½	Freeport Texas	42½	43	38½	41½
36½	31	Glidden Co	34½	36½	33	35
46½	37½	Gold Dust	45½	46½	41½	42½
51½	40½	Goodrich Co	45½	51½	45½	47½
85	78½	Hercules Powder	....	81½	76	....
70½	52½	Houston Oil	58½	70½	57½	67½
124	90	Industrial Rayon	....	113½	90	108½
7½	4½	Int. Ag. Chemical	6	6½	5½	....
15½	12½	International Paper, C	13½	15½	13	14½
77	69	International Salt	75	75	70	74
23	20½	Kellogg, Spencer & Sons	21	22	20½	21½
5½	3½	Kelly-Springfield	5	5½	4½	4½
9	6½	Lee Rubber and Tire	8	9	7½	7½
34	29½	Lehn & Fink	....	34	30½	31
27½	19½	Libby-Owens	26½	26½	23	23
65½	52½	Liquid Carbonic	60½	65½	58½	65½
46½	37½	Mathieson Alkali	41½	46½	40½	43½
60	49	Monsanto Chemical	59½	59½	53	56
39½	36	Nat'l Distillers Products	37½	39½	34½	37½
189½	137	National Lead	....	189½	166½	179
85½	66½	New Jersey Zinc	....	85½	76½	84½
71½	66½	Ohio Oil	70½	70½	66½	68
60½	52½	Owens-Ill. Glass	55	60½	55	....
35	29½	Phillips Petroleum	34	34½	29½	31½
58½	53	Pittsburgh Plate Glass	....	55	55	....
57½	55½	Pratt & Lambert	....	55½	55½	....
70½	52½	Procter & Gamble	68	....	....	67
24½	21½	Pure Oil	23½	24	21½	22
....	....	Sherwin-Williams	....	....	....	....
30	18	Silica Gel	....	30	23½	28½
25½	21½	Sinclair Oil	25½	25½	21½	24½
32½	28½	Skelly Oil	32½	32½	28½	29½
61½	55½	Standard Oil, Cal.	60½	61½	55½	58½
66½	58	Standard Oil, N. J.	64½	65½	58	58½
33½	31½	Standard Oil, N. Y.	32½	33½	31½	32½
3	1½	Standard Plate Glass	....	3	1½	2
59½	53	Sun Oil	57½	57½	53	....
....	....	Swan & Finch	....	....	....	....
34½	32½	Swift & Co.	....	....	....	....
16½	13	Tennessee Copper & Chemical	14½	16½	14½	14½
56½	50½	Texas Corporation	54½	....	50½	52½
64½	54½	Texas Gulf Sulphur	61½	64½	60½	63
21½	19½	Tidewater Oil	....	....	....	....
178½	130	Tubize Silk	148	152	130	....
94½	76	Union Carbide	92	94½	87½	92½
46½	41½	Union Oil, Cal.	44½	44½	41½	42½
32	19½	United Chemicals	....	42	19½	....
29½	25	United Piece Dye	....	29½	25	....
139½	110½	U. S. Industrial Alcohol	120½	124½	115½	118½
9½	7½	U. S. Leather	9	9	8	....
29½	21½	U. S. Rubber	26½	29½	24½	27
96½	88½	Vacuum Oil	96½	96½	88½	91½
73½	49½	Vanadium Corp	65½	73½	62½	69½
41½	37½	Vick Chemical	40	41½	37½	40
7½	5½	Va.-Ca. Chemical	6½	6½	5½	6
28	22½	Wesson Oil	25½	28	25	26½
59½	37	Westvaco Chlorine	....	59½	39½	....
4½	3½	Wilson & Co.	3½	4½	3½	....

CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York Market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to March 13.

Industrial Chemicals

	Current Price	Last Month	Last Year
Acetone, drums, lb.	$0.11 -$0.12	$0.11 -$0.12	$0.14 -$0.15
Acid, acetic, 28%, bbl., cwt.	3.88 - 4.03	3.88 - 4.03	3.88 - 4.03
Boric, bbl, lb.	.06½- .07	.06½- .07	.06½- .07
Citric, kegs, lb.	.46 - .47	.46 - .47	.46 - .47
Formic, bbl, lb.	.10½- .11	.10½- .11	.10½- .11
Gallic, tech., bbl., lb.	.50 - .55	.50 - .55	.50 - .55
Hydrofluoric 30% carb, lb.	.06 - .07	.06 - .07	.06 - .07
Latic, 44%, tech., light, bbl., lb.	.11½- .12	.11½- .12	.12 - .12½
22%, tech., light, bbl., lb.	.05½- .06	.05½- .06	.05½- .06
Muriatic, 18°, tanks, cwt.	1.00 - 1.10½	1.00 - 1.10	.90 - 1.00
Nitric, 36°, carboys, lb.	.05 - .05½	.05 - .05½	.05 - .05½
Oleum, tanks, wks., ton	18.50 -20.00	18.50 -	18.00- 20.00
Oxalic, crystals, bbl., lb.	.11 - .11½	.11½- .11½	.11 - .11½
Phosphoric, tech., c'bys., lb.	.08½- .09	.08½- .09	.08½- .09
Sulphuric, 60°, tanks, ton	11.00 -11.50	11.00 -11.50	11.00 -11.50
Tannic, tech., bbl., lb.	.35 - .40	.35 - .40	.35 - .40
Tartaric, powd., bbl., lb.	.38½- .39	.38½- .39	.38 - .39
Tungstic, bbl., lb.	1.40 - 1.50	1.40 - 1.50	1.00 - 1.20
Alcohol, ethyl, 190 p'f., bbl., gal.	2.63 -	263- 2.71	2.68½- 2.71
Alcohol, Butyl, tanks, lb.	.16½- .17	.16½- .17	.18½- .19
Alchol, Amyl, dr. ga.	1.90 - 2.10	-	-
From Pentane, tanks, lb.	.236-	.236-	-
Denatured, 190 proof			
No. 1 special dr., gal.	.49 -	.49 -	.48 -
No. 5, 188 proof, dr., gal.	.50 -	.50 -	.48 -
Alum, ammonia, lump, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chrome, bbl., lb.	.05½- .05½	.05½- .05½	.05½- .06
Potash, lump, bbl., lb.	.03½- .04	.03 - .03½	.02½- .03½
Aluminum sulphate, com., bags, cwt.	1.40 - 1.45	1.40 - 1.45	1.40 - 1.45
Iron free, bg., cwt.	1.90 - 2.00	2.00 - 2.10	2.00 - 2.10
Aqua ammonia, 26°, drums., lb.	.03 - .04	.03 - .04	.03 - .04
Ammonia, anhydrous, cyl., lb.	.15 -	.15 -	.14 -
Ammonium carbonate, powd. tech., casks, lb	.12½- .13	.12½- .13	.12 - .13
Sulphate, wks., cwt	2.05 -	2.10 -	2.30 -
Amylacetate tech., drums, gal.	1.70 - 1.90	1.70 - 1.90	1.75 - 2.00
Synthetic, tanks, lb	.222-	.222-	-
Antimony Oxide, bbl., lb.	.09 - .10	.09 - .10	.09 - .10
Arsenic, white, powd., bbl., lb.	.04 - .04½	.04 - .04½	.04 - .04½
Red, powd., kegs., lb	.09 - .10	.09 - .10	.09 - .10
Barium carbonate, bbl., ton	58.00 -60.00	58.00 -60.00	57.50 -60.00
Chloride, bbl., ton	63.00 -65.00	65.00 -67.00	64.00 -70.00
Nitrate, cask, lb.	.07½- .07½	.07½- .08	.08 - .08½
Blanc fixe, dry, bbl., lb.	.03½- .04	.03½- .04	.04 - .04½
Bleaching powder, f.o.b., wks., drums, cwt.	2.00 - 2.10	2.00 - 2.10	2.00 - 2.10
Borax, bbl., lb.	.033- .033	.033- .033	.02½- .03
Bromine, cs., lb.	.45 - .47	.45 - .47	.45 - .47
Calcium acetate, bags., cwt.	4.50 -	4.50 -	4.50 -
Arsenate, dr., lb	.07 - .08	.07 - .10	.06½- .07
Carbide drums, lb.	.05 - .06	.05 - .06	.05 - .06
Chloride, fused, dr., wks., ton.	20.00 -	20.00 -	20.00 -
flake, dr., wks., ton.	22.75 -	22.75 -	22.75 -
Phosphate, bbl., lb.	.08 - .08½	.08 - .08½	.07 - .07½
Carbon bisulphide, drums, lb.	.05 - .05½	.05 - .06	.05 - .06
Tetrachloride drums, lb.	.06½- .07	.06½- .07	.06½- .07
Chlorine, liquid, tanks, wks., lb.	.02½-	.02½-	.03 -
Cylinders	.04½- .06	.04½- .06	.05 - .08
Cobalt oxide, cans, lb.	2.10 - 2.20	2.10 - 2.20	2.10 - 2.25
Copperas, bgs., f.o.b. wks., ton.	14.00 -15.00	15.00- 16.00	16.00 -17.00
Copper carbonate, bbl., lb.	.13 - .20	.13 - .20	.17 - .18
Cyanide, tech., bbl., lb.	.45 - .46	.49 - .50	.49 - .50
Sulphate, bbl., cwt.	5.50 - 6.00	5.50 - 6.00	6.20 - 6.40
Cream of tartar, bbl., lb.	.26½ - .27	.26½ - .27	.27½ - .28
Diethylene glycol, dr., lb.	.11 - .13	.10 - .15	.10 - .15
Epsom salt, dom., tech., bbl., cwt.	1.75 - 2.15	1.75 - 2.00	1.75 - 2.00
Imp., tech., bags, cwt	1.15 - 1.25	1.15 - 1.25	1.15 - 1.25
Ethyl acetate, drums, lb.	.121-	.121-	.12 5 -
Formaldehyde, 40%, bbl., lb.	.07½- .08	.07½- .08	.09½- .10
Furfural, dr., lb.	.15 - .17½	.15 - .17½	.15 - .17
Fusel oil, crude, drums, gal.	1.30 - 1.40	1.30 - 1.40	1.30 - 1.40
Refined, dr., gal.	1.90 - 2.00	1.90 - 2.00	2.50 - 3.00
Galubers salt, bags, cwt.	1.10 - 1.20	1.10 - 1.20	1.00 - 1.10
Glycerine, c.p., drums, extra., lb.	.14 - .14½	.14 - .14½	.14 - .15
Lead:			
White, basic carbonate, dry casks, lb.	.08½-	.08½-	.08½-
White, basic sulphate, sck., lb.	.07½-	.07½-	.08 -
Red, dry, sck., lb	.09½-	.09½-	.11 -
Lead acetate, white crys., bbl., lb.	.13 - .14	.13 - .14	.13 - .13½
Lead arsenate, powd., bbl., lb.	.13 - .14	.14 - .15	.12 - .13
Lime, chem., bulk, ton	8.50 -	8.50 -	8.50 -
Litharge, pwd., csk, lb	.08½-	.08½-	.08½-
Lithopone, bags, lb.	.05½- .06	.05½- .06	.05½- .06½
Magnesium carb., tech., bags, lb.	.06 - .06½	.06 - .06½	.06½- .07
Methanol, 95%, tanks, gal.	.43 -	.43 -	.55 -
97%, tanks, gal.	.45 -	.45 -	.55 -
Synthetic, tanks, gal.	.43 - .45		
Nickel salt, double, bbl., lb.	.13 - .14	.13 - .13½	.10 - .11
Single, bbl., lb.	.13 - .13½	.13 - .13½	.10½- .11½
Orange mineral, csk., lb.	$0.11½-	.11½-	.12½-
Phosphorus, red, cases, lb.	.42 - .44	.42 - .44	.55 - .57
Yellow, cases, lb.	.31 - .32	.31 - .32	.32 - .33
Potassium bichromate, casks, lb.	.09 - .09½	.09 - .09½	.09 - .09½
Carbonate, 80-85%, calc., csk., lb	.05½- .06	.05½- .06	.05½- .06
Chlorate, powd., lb.	.08½- .09	.08½- .09	.06½- .07
Cyanide, cs., lb.	.52 - .55	.52 - .55	.51 - .53
First sorts, csk., lb.	.08½- .09	.08½- .09	.08½- .09
Hydroxide (c'stic potash) dr., lb	.06½- .06½	.06½- .06½	.07½- .07½
Muriate, 80% bgs., ton	36.75 -	36.75 -	36.40 -
Nitrate, bbl., lb.	.06 - .06½	.06 - .06½	.06 - .07½
Permanganate, drums, lb.	.16 - .16½	.16 - .16½	.15 - .16
Prussiate, yellow, casks, lb	.18½- .19½	.18½- .19	.19 - .19½
Sal ammoniac, white, casks, lb	.046- .05	.046- .05	.047- .05
Salsoda, bbl., cwt.	.90 - .95	.90 - .95	.90 - .95
Salt cake, bulk, ton	22.00 -24.00	22.00 -24.00	15.00 -17.00
Soda ash, light, 58%, bags, contract, cwt.	1.32 -	1.32 -	1.32 -
Dense, bags, cwt.	1.35 -	1.35 -	1.35 -
Soda, caustic, 76%, solid, drums, contract, cwt.	2.90 - 3.00	2.90 - 3.00	2.90 - 3.00
Acetate, works, bbl., lb.	.03 - .04	.04 - .04½	.05 - .05½
Bicarbonate, bbl., cwt.	2.00 - 2.25	2.00 - 2.25	2.00 - 2.25
Bichromate, casks, lb.	.07 - .07½	.07 - .07½	.07 - .07½
Bisulphate, bulk, ton.	16.00 -18.00	16.00 -18.00	12.00 -15.00
Bisulphite, bbl., lb.	.03½- .04	.03½- .04	.03½- .04
Chlorate, kegs, lb	.07½- .08	.07½- .08	.06½- .06½
Chloride, tech., ton	12.00- 14.75	12.00- 14.75	12.00 -14.00
Cyanide, cases, dom., lb.	.18 - .22	.18 - .22	.18 - .22
Fluoride, bbl., lb.	.08½- .09½	.08½- .09½	.08½- .09
Hyposulphite, bbl., lb.	2.40 - 2.50	2.40 - 2.50	2.50 - 3.00
Nitrate, bags, cwt.	2.16 -	2.10 -	2.15 -
Nitrite, casks, lb.	.07½- .08	.07½- .08	.07½- .08
Phosphate, dibasic, bbl., lb.	.03 - .03¼	.03½- .03½	.03½- .03½
Prussiate, yel. drums, lb.	.11½- .12	.11½- .12	.11½- .12
Silicate (30°, drums), cwt.	.60 - .70	.70 - .80	.75 - 1.15
Sulphide, fused, 60-62%, dr., lb.	.02½- .03½	.02½- .03	.03½- .04
Sulphite, crys., bbl., lb.	.03 - .03½	.03 - .03½	.02½- .03
Strontium nitrate, bbl., lb.	.03 - .03½	.03 - .03½	.02 - .03½
Sulphur, crude at mine, bulk, ton	18.00 -	18.00 -	18.00 -
Chloride, dr., lb.	.05 - .06	.04 - .05	.04 - .05
Dioxide, cyl., lb.	.07 - .08	.07 - .08	.09 - .10
Flour, bag, cwt.	1.55 - 3.00	1.55 - 3.00	1.55 - 3.00
Tin bichloride, bbl., lb.	nom. -	.13 -	.15½-
Oxide, bbl., lb.	.41 -	.42 -	.54 -
Crystals, bbl., lb.	.30½-	.32 -	.37½-
Zinc chloride, gran., bbl., lb.	.06½- .06½	.06½- .06½	.06½- .06½
Carbonate, bbl., lb.	.10½- .11	.10½- .11	.10 - .11
Cyanide, dr., lb.	.41 - .42	.40 - .41	.40 - .41
Dust, bbl., lb.	.07½- .08	.08 - .08½	.09 - .10
Zinc oxide, lead free, bag, lb.	.06½-	.06½-	.06½-
5% lead sulphate, bags, lb.	.06½-	.06½-	.06½-
Sulphate, bbl., cwt.	3.00 - 3.25	2.75 - 3.00	2.75 - 3.00

Oils and Fats

	Current Price	Last Month	Last Year
Castor oil, No. 3, bbl., lb.	$0.12 -$0.12½	$0.12½-$0.13	$0.13½-$0.14
Chinawood oil, bbl., lb.	.11½-	.12½-	.14½-
Coconut oil, Ceylon, tanks, N.Y., lb.	.06½-	.07 -	.08 -
Corn oil crude, tanks, (f.o.b. mill), lb.	.07½-	.07½-	.09½-
Cottonseed oil, crude (f.o.b. mill), tanks, lb.	.07 -	.07½-	.09½-
Linseed oil, raw, car lots, bbl., lb.	.138-	.14 -	.102-
Palm, Lagos, casks, lb	.07½-	.07½-	.09½
Niger, casks, lb.	.07 -	.07½-	.09 -
Palm Kernel, bbl., lb.	.07½-	.07½-	.09½-
Peanut oil, crude, tanks (mill), lb	.07½-	.07½-	.10 -
Rapeseed oil, refined, bbl., gal.	.68 - .70	.71 - .73	.86 - .87
Soya bean, tank (f.o.b. Coast), lb.	.09½-	.09½-	.09½-
Sulphur (olive foots), bbl., lb.	.07½-	.07½-	.10½-
Cod, Newfoundland, bbl., gal.	.57 - .59	.59 - .60	.65 .67
Menhaden, light pressed, bbl., gal.	.63 - .65	.64 - .66	.60 .61
Crude, tanks (f.o.b. factory), gal.	nom. -	.45 -	.48 -
Whale, crude, tanks, gal	.80 -	.80 -	- .80
Grease, yellow, loose, lb.	.05½-	.06½-	.07½-
Oleo stearine, lb.	.09½-	.11½-	.09½-
Red oil, distilled, d.p. bbl., lb	.10 - .10½	.09½- .10	.09½- .09½
Tallow, extra, loose, lb	.06½-	.07½-	.08½-

Coal-Tar Products

	Current Price	Last Month	Last Year
Alpha-naphthol, crude, bbl., lb.	$0.60 -$0.65	$0.60 -$0.65	$0.60 -$0.62
Refined, bbl., lb.	.80 - .85	.80 - .85	.85 - .90
Alpha-naphthylamine, bbl., lb.	.32 - .34	.32 - .34	.35 - .36
Aniline oil, drums, extra, lb.	.15 - .15½	.14½- .15	.15 - .16
Aniline salts, bbl., lb.	.24 - .25	.24 - .25	.24 - .25
Anthracene, 80%, drums, lb.	.60 - .65	.60 - .65	.60 - .65

Coal-Tar Products (Continued)

	Current Price	Last Month	Last Year
Benzaldehyde, U.S.P., dr., lb.	1.15 - 1.25	1.15 - 1.35	1.15 - 1.25
Benzidine base, bbl., lb.	.65 - .67	.65 - .67	.70 - .72
Benzoic acid, U.S.P., kgs, lb.	.57 - .60	.57 - .60	.58 - .60
Benzyl chloride, tech., dr., lb.	.25 - .26	.25 - .26	.25 - .26
Benzol, 90%, tanks, works, gal.	.22 - .24	.22 - .24	.22 - .23
Beta-naphthol, tech., drums, lb.	.22 - .24	.22 - .24	.22 - .24
Cresol, U.S.P., dr., lb.	.14 - .17	.14 - .17	.18 - .20
Cresylic acid, 97%, dr., wks., gal.	.66 - .70	.73 - .75	.73 - .75
Diethylaniline, dr., lb.	.55 - .58	.55 - .58	.58 - .60
Dinitrophenol, bbl., lb.	.30 - .32	.30 - .31	.31 - .35
Dinitrotoleun, bbl., lb.	.16 - .17	.17 - .18	.17 - .18
Dip oil, 25% dr., gal.	.26 - .28	.26 - .28	.28 - .30
Diphenylamine, bbl., lb.	.39 - .40	.39 - .40	.45 - .47
H-acid, bbl., lb.	.68 - .70	.65 - .70	.63 - .65
Naphthalene, flake, bbl., lb.	.04½ - .05	.04½ - .05	.05 - .06
Nitrobenzene, dr., lb.	.08½ - .09	.09 - .10	.08½ - .10
Para-nitraniline, bbl., lb.	.51 - .55	.51 - .55	.52 - .53
Para-nitrotoluine, bbl., lb.	.29 - .30	.29 - .31	.28 - .32
Phenol, U.S.P., drums, lb.	.14½ - .15	.14½ - .15	.15 - .17
Picric acid, bbl., lb.	.30 - .40	.30 - .40	.30 - .40
Pyridine, dr., lb.	1.75 - 1.90	1.75 - 1.90	1.35 - 1.50
R-salt, bbl., lb.	.44 - .45	.44 - .45	.47 - .49
Resorcinal, tech., kegs, lb.	1.15 - 1.25	1.15 - 1.25	1.30 - 1.40
Salicylic acid, tech., bbl., lb.	.33 - .5	.33 - .35	.30 - .32
Solvent naphtha, w.w., tanks, gal	.28 - .30	.30 -	.35 -
Tolidine, bbl., lb.	.91 - .93	.91 - .93	.95 - .96
Toluene, tanks, works, gal.	.35 -	.40 -	.35 -
Xylene, com., tanks, gal.	.28 .30	.30 - .35	.36 - .40

Miscellaneous

	Current Price	Last Month	Last Year
Barytes, grd., white, bbl., ton	$23.00-$25.00	$23.00-$25.00	$23.00-$25.00
Casein, tech., bbl., lb.	.14 - .15	.14½ - .15	.16½ - .17
China clay, dom., f.o.b. mine, ton	8.00 -20.00	10.00 -20.00	10.00 -20.00
Dry colors:			
Carbon gas, black (wks.), lb.	.05 - 22	.06 - .13	.06½ - 07
Prussian blue, bbl., lb.	.35 - .36	.35 - .36	31 - .32
Ultramine blue, bbl., lb.	.06 - 32	.06 - 32	03 - .35
Chrome green, bbl., lb.	.27 - 28	27 - 28	.27 - .30
Carmine red, tins, lb.	6 00 - 6 50	6 00 - 6 50	5.25 - 5 50
Para toner, lb	77 - 80	75 - 80	.70 - 80
Vermilion, English, bbl., lb.	1 90 2 00	1 90 - 2 00	1.80 1.85
Chrome yellow, C. P., bbl., lb.	17 - 17½	17 - 17½	15½ - 16
Feldspar, No. 1 (f.o.b. N.C.), ton	6 50 - 7 50	6 50 - 7 50	5.75 - 7 00
Graphite, Ceylon, lump, bbl., lb.	04 - 05	.04 - 05	.08 - 09
Cum copal Congo, bags, lb.	07½ - 08	.07½ - 08	.07½ - 08
Manila, bags, lb.	16 - 17	.16 - 17	.15 - 18
Damar, Batavia, cases, lb.	18 - 19	.21 - 22	.22 - 23
Kauri No. 1 cases, lb.	48 - 50	48 - 53	48 - 53
Kieselguhr (f.o.b. N. Y.), lb.	50 00 -55 00	50 00 -55 00	50 00 - 55 00
Magnesite, calc, ton	40 00 -	40 00 -	40 00 -
Pumice stone, lump, bbl., lb.	.05 - 07	.05 - .08	.05 - 07
Imported, casks, lb.	03 - 40	03 - .40	03 - 35
Rosin, H., bbl.	8.20 -	8 70 -	9 25 -
Turpentine, gal.	.54½ - 55½	54½ -	.58 -
Shellac, orange, fine, bags, lb.	55 - 58	59 - .60	61 - 62
Bleached, bonedry, bags, lb.	38 - 40	38 - 40	.56 - 60
T. N. bags, lb.	27 - 28	35 - 36	46 - 47
Soapstone (f.o.b. Vt.), bags, ton	10 00 -12 00	10 00 -12 00	10 00 -12 00
Talc, 200 mesh (f.o.b. Vt.), ton	9 50 -	9 50 -	10 50 -
300 mesh (f.o.b. Ga.), ton	7 50 -10.00	7 50 -10.00	7.50 -11.00
225 mesh (f.o.b. N. Y.), ton	13 75 -	13 75 -	13.75 -

	Current Price	Last Month	Last Year
Wax, Bayberry, bbl., lb.	$0.27 - $0 29	$0 27 - $0.29	$0 31 - $0 32
Beeswax, ref., light, lb.	.36 - .37	37 - 40	.41 - 42
Candelilla, bags, lb.	.19 - 20	.21 - .23	.23 - .24
Carnauba, No. 1, bags, lb.	.31 - .32	.32 - .34	.50 - .51
Paraffine, crude 105-110 m.p., lb.	.04½ - 05	04½ - .05	.04½ - .05

Ferro-Alloys

	Current Price	Last Month	Last Year
Ferrotitanium, 15-18%, ton	$200 00-	$200.00-	$200.00-
Ferromanganese, 78-82%, ton	100 00	105 00-	105 00-
Spiegeleisen, 19-21%, ton	33 00	33 00-	32.00-
Ferrosilicon, 14-17%, ton	45 00	45 00-	45.00-
Ferrotungsten, 70-80%, lb.	1 45	1 45-	1.35- .98
Ferro-uranium, 35-50%, lb.	4 50	4.50-	4.50-
Ferrovanadium, 30-40%, lb.	3 15 3 75	3.15- 3.75	3.15- 3.75

Non-Ferrous Metals

	Current Price	Last Month	Last Year
Copper, electrolytic, lb.	$0.17½-	$0.17½ -	$0.20 -
Aluminum, 96-99%, lb.	.24 - .30	.24 - .26	.24 - .25
Antimony, Chin. and Jap., lb.	.08½-	08¼-	.09¼ -
Nickel, 99%, lb.	.35 -	35 -	35 -
Monel metal, blocks, lb.	28 -	28 - .28	28 -
Tin, 5-ton lots, Straits, lb.	.36½-	38¾ -	48¾
Lead, New York, spot, lb.	.05 -	06½ -	.07¼
Zinc, New York, spot, lb.	.053-	056-	.06¼
Silver, commercial, oz.	41¼ -	43¼ -	56¼
Cadmium, lb.	80 - .85	85 - .95	85 .95
Bismuth, ton lots, lb.	1 70 -	1 70 -	1 70
Cobalt, lb.	2 10 - 2.50	2 10 - 2.50	2 50 -
Magnesium, ingots, 99%, lb.	85 - 1.10	85 - 1.10	85 1.10
Platinum, ref., oz.	55 00 56.00	61 00 - 63.00	70 00 70.00
Palladium ref., oz.	30 00 35 00	35 00 - 36.00	42 00 46.00
Mercury, flask, 75 lb.	120 00	120.00 -	123 00 -
Tungsten powder, lb.	1.35 1 50	1.35 - 1.50	1 10 - 1.15

Ores and Semi-finished Products

	Current Price	Last Month	Last Year
Bauxite, crushed, wks., ton	$7 50 - $8 00	$7.50- $8.50	$5 50 - $8 75
Chrome ore, c.f. post, ton	21 50- 25 00	21 50- 25 00	22 00- 23 00
Coke, fdry., f.o.b. ovens, ton	2 75- 2 85	2 75- 3 85	2 85 - 3 00
Fluorspar, gravel, f.o.b. Ill., ton	18 00- 20.00	18.00- 20.00	17.00- 18.00
Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit	.31 - .36	.31 - .36	.36 - .38
Molybdenite, 85% MoS_2 per lb. MoS_2, N. Y., lb.	.48 - .50	48 - .50	48 - .50
Monazite, 6% of ThO_2, ton	60.00-	60 00-	130.00-
Pyrites, Span. fines, c.i.f., unit	.13 -	.13 -	.13 -
Rutile, 94-96% TiO_2, lb.	.10 - .11	.10 - .11	.11 - .13
Tungsten, scheelite, 60% WO_3 and over, unit	15 25- 16.50	15 25 -16.50	11 25 -11 50
Vanadium ore, per lb. V_2O_5, lb.	28.00-	.28 -	nom. - nom.
Zircon, 99%, lb.	.03 -	03 -	.03 -

CURRENT INDUSTRIAL DEVELOPMENTS

New Construction and Machinery Requirements

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Alloy Factory—General Alloy Co., 188 New Jersey Railroad Ave., Newark, N. J., will receive bids about Mar. 15 for the construction of a 2 story alloy factory on Maple Pl. Estimated cost $40,000. P. B. West, 24 Commerce St., Newark, is architect.

Aluminum Factory—The Aluminum Industries Inc., Beekman St., Cincinnati, O., awarded contract for the construction of two 1 story factory buildings, one to Fisher-DeVore Co., Dana St., Cincinnati and one to Truson Steel Co., 505 Walnut St., Cincinnati. Estimated total cost $100,000.

Aluminum Parts Factory—Bohn Aluminum & Brass Corp., 2512 East Grand Blvd., Detroit, Mich., is having plans prepared for the construction of a 1 and 4 story factory for the manufacture of automobile parts and other aluminum products. Estimated cost $1,000,000. C. W. Brandt, 1016-18 Francis Palms Bldg., Detroit, is architect.

Asphalt plant—W. P. McDonald Construction Co., 381 4th Ave., New York, N. Y., will build an asphalt plant at Lawrence St., and Broadway, Flushing. Estimated cost $25,000. M. Kramer, Sr., c/o owner, Archt. Work will be done by day labor.

Laboratory, Etc.—Barber Asphalt Co., 420 Lexington Ave., New York, N. Y., awarded contract for the design and construction of a 2 story laboratory and office building at Maurer, N. J., to Day & Zimmermann Engineering & Construction Co., 165 Broadway, New York, N. Y. Estimated cost $180,000.

Brass Factory—N. N. Hill Brass Co., 25 Skinner St., East Hampton, Conn., awarded contract for the construction of a 2 story, 40 x 100 ft. factory, to N. P. Clark, 350 Ridge Rd., Wethersfield. Estimated cost $40,000.

Cement Plant—Russia Cement Co., Essex Ave., West Gloucester, Mass., awarded contract for additional unit to cement plant to C. C. Fears, 46 High St., Rockport. Estimated cost $40,000.

Cement Storage Bins — Canada Cement Co. Ltd., H. O. Canada Cement Bldg., Montreal, Que., plans the construction of two cement storage bins, approximately 60 ft. high at Windsor, Ont. Estimated cost $50,000. Private plans.

Ceramics Factory Addition—General Ceramics Co., Keasbey, N. J., will soon award contract for a 1 story, 80 x 130 ft. addition to factory, including kiln, furnaces, dryer, etc. Estimated cost $50,000. Detrich Wortmann, 116 Lexington Ave., New York, N. Y., are architects.

Chemical Plant—Davison Chemical Co., Baltimore Trust Building, Baltimore, Md., is having plans prepared for the construction of a 230 x 350 ft. chemical plant at Houston, Tex. Estimated cost $750,000. Engineering Service Corp., 923 Post Dispatch Bldg., Houston, Tex., is engineer.

Chemical Factory—R. Ludwig, 316 West 56th St., New York, N. Y., Archt., is receiving bids for the construction of a 5 story, 50 x 100 ft. chemical factory and storage building at Jersey City, N. J. for Gergy Co. Inc., 58 Mill Rd., Jersey City. Estimated cost $75,000.

Chemical Plant — Plough Chemical Co., 121 South Second St., Memphis, Tenn., rejected bids for a 5 story chemical plant at South Parkway and Southern R.R. Estimated cost $1,000,000. Will readvertise.

Chemical Plant, Mills, etc.—Southern Mineral Products Co., subsidiary of Vanadium Corp. of America, 120 Broadway, New York, N. Y., awarded contract for the design and construction of first unit of mining, milling and chemical plant in Amherst and Nelson counties, Virginia, to Stone & Webster, 120 Broadway, New York, N. Y. Estimated cost $1,500,000.

Chemical Plant Addition—Consolidated Chemical Industries, Financial Center Bldg., San Francisco, Calif., awarded contract for addition to chemical plant at South San Francisco to The Austin Co. of California, Russ Bldg., San Francisco. Estimated cost $250,000.

Concrete Pipe and Roofing Material Factory—The Castle Stone Co., A. E. Ault, V. Pres., 320 Glass St., New Castle, Pa., plans the construction of a 1 story factory for the manufacture of concrete pipe and roofing materials at New Castle Junction. Estimated cost $150,000. Private plans.

Enameling Plant — Tennessee Stove Works, Greenwood Ave., Chattanooga, Tenn., awarded contract for the construction of a 1 story enameling plant to Rogers & Leventhal, 822 East 11th St., Chattanooga. Estimated cost $30,000.

Explosive Plant—Coast Mfg. Co., Livermore, Calif., manufacturers of explosives, awarded contract for the construction of a 2 story building for testing and storage of fuses for explosive use to The Austin Co., 16112 Euclid Ave., Cleveland, O. Estimated cost $60,000.

Gas Plant—Inland Empire Gas Co., Brawley, Calif., plans the construction of a plant to manufacture gas from fuel oil. Estimated cost $150,000.

Gas Plant—Southeastern Illinois Gas Co., c/o Utilities Gas & Electric Co., 22 West Monroe St., Chicago, Ill., awarded contract for the construction of a gas plant at Harrisburg to W. Boatright, Harrisburg. Estimated cost including equipment $250,000. Also plans gas plant, storage tanks, distribution lines, etc. at Carmi, $100,000, and similar plants at El Dorado, Fairfield and Metropolis, Ill.

Gas and Coking Plant—Canadian Terminals System, 34 King St., E. Toronto, Ont., plans the construction of a gas and coking plant at Fort William. Estimated cost $1,000,000. Engineer not selected.

Gasoline Plant—Amerada Petroleum Co., Petroleum Bldg., Tulsa, Okla., plans the construction of a natural gas casinghead gasoline plant at Oklahoma City. Estimated cost $100,000. Private plans.

Gasoline Plant—Indian Territory Illuminating Oil Co., Commerce Bldg., Oklahoma City, Okla., is having plans prepared for the construction of a casinghead gasoline plant. Estimated cost $75,000. Private plans.

Glass Plant—Libby-Ownens Glass Co., J. C. Blair, Pres., Nicholas Bldg., Toledo, O., will soon award contract for addition to laminated glass plant on East Broadway. Estimated cost $500,000.

Glass Factory—Pittsburgh Plate Glass Co., 193 Hunters Point Ave., Long Island, N. Y., plans the construction of a warehouse in connection with glass factory at Mineola. Estimated cost to exceed $100,000. Architect not selected.

Glass Plant—Western States Plate Glass Co., Salt Lake City, Utah, c/o F. E. McCambridge, Pres. and Treas. of Middle States Bond & Investment Co., 818 Olive St., St. Louis, Mo., plans the construction of a glass plant at Salt Lake City. Estimated cost $5,000,000. H. L. Dixon & Co., Rosslyn Rd., Pittsburgh, Pa., are architects.

Graphite Factory — Colloidal Graphite Co., 812 Foreman Bldg., Los Angeles, Calif., plans the construction of a 3 story graphite factory. Estimated cost $60,000.

Graphite Factory—International Graphite & Electrode Co., Niagara Falls, N. Y., awarded contract for structural steel for a 1 story, 114 x 185 ft. graphite factory to Pittsburgh Bridge & Iron Co., Bessemer Bldg., Pittsburgh, Pa.

Chemistry Building—Indiana University, Bloomington, Ind., awarded contract for the construction of a chemistry building to E. A. Carson, 1201 East 30th St., Indianapolis. Estimated cost $519,000.

Chemistry Building—Miami University, Oxford, O., will receive bids until May 1 for the construction of a 2 story, 100 x 100 ft. chemistry building. Estimated cost $150,000. Private plans.

Laboratory (Drug)—New York Consolidated Drug Co., 188 Pearl St., New York, N. Y., plans addition to laboratory and storage building at 36 West 22nd St. Estimated cost to exceed $40,000.

Laboratory (Experimental)—Firth Sterling Steel Co., L. J. Firth, Pres., McKeesport, Pa., will soon award contract for the construction of a 2 and 3 story, 50 x 120 ft. experimental laboratory building. United Engineers & Constructors Inc., Broad and Arch Sts., Philadelphia, are engineers.

Laboratories, etc.—Bd. of Education, 911 Locust St., St. Louis, Mo., will receive bids until Apr. 2, for the construction of first unit of vocational school including laboratories, etc. at Bell, School and Channing Sts. G. W. Sanger, is acting building commissioner.

Match Factory—Universal Match Co., A. H. Rosenberg, Pres., Ferguson Mo., will soon receive bids for the construction of a 2 story match factory on Short St. Estimated cost $85,000.

Paint Factory—Caldow Paint Co., 1422-14th Ave., Oakland, Calif., is having plans prepared for the construction of a 3 story paint factory on 14th Ave. Estimated cost to exceed $40,000. C. McCall, 1404 Franklin St., Oakland, is architect.

Paint Manufacturing Plant—Pittsburgh Plate Glass Co., 205 Pittsburgh Ave., Milwaukee, Wis., will receive bids about Apr. 1 for the construction of a 5 story paint manufacturing plant. Estimated cost $1,000,000. Private plans.

Varnish Factory—Boston Varnish Co., Boston and Second Sts., Everett, Mass., will soon award contract for addition and alterations to varnish factory. Estimated cost $140,000 to $160,000. C. L. Betton, 31 Exchange St., Lynn, Mass., is architect.

Emulsion Plant—Pioneer Paper Co., 5500 South Alameda St., Los Angeles, Calif., is having plans prepared for the construction of a 2 and 3 story, 50 x 160 ft. emulsion plant. Estimated cost $40,000. Hamm, Grant & Brunner, Ferguson Bldg., Los Angeles, are engineers.

Paper Manufacturing Plant—Brown Co., 404 Commercial St., Portland, Me., plans improvements to paper manufacturing plant. Estimated cost $300,000 to $400,000 including equipment. Private plans.

Paper Plant—Superior Paper Products Co., Carnegie, Pa., will soon award contract for the construction of a 1 story, 180 x 360 ft. paper plant. Estimated cost $150,000. Braziell & Anderson, 309 4th Ave., Pittsburgh, Pa., are architects.

Paper Warehouse — Consolidated Paper Co., Monroe, Mich., awarded contract for the construction of a 1 story, 120 x 580 ft. paper warehouse to W. H. Knapp Co., Monroe. Estimated cost $175,000. Machinery and equipment for handling paper stock will be required

Pulp Mill—Backus-Brooks Co., 1100 Builders Bldg., Minneapolis, Minn., plans the construction of first unit of plant for the manufacture of insulating material of wood pulp at Karhula, Finland, to include hydro-electric development, 25,000 hp. capacity at Abborsfors Rapids. Total estimated cost $5,000,000. Plant will be operated by Ahlstrom Co., Finland; surveys are also being made for a wall board manufacturing plant in vicinity of Helsingfors to exceed $1,000,000.

Pulp Mill—Pacific States Pulp & Paper Co., A. T. Peterson, Priest River, V. Pres., 71 Columbia St., Seattle, Wash., is having preliminary plans prepared for the construction of a pulp mill 100 ton of sulphate pulp daily capacity at Priest River. Estimated cost $1,500,000.

Pulp and Paper Mill—Pacific Coast Pulp & Paper Corp., Richvale, Calif., awarded contract for the construction of a pulp and paper mill to C. Mabrey Co. Inc., 1001 45th St., Sacramento. Estimated cost $245,000.

Prest-O-Lite Plant—Prest-O-Lite Co., 30 East 42nd St., New York, N. Y., awarded contract for the construction of a 1 and 2 story, 58 x 96 ft. plant at Stewart Ave. and Atlanta St. and West Point Ry. belt line, Atlanta, Ga. to A. K. Adams Co., 542 Plum St. N. W., Atlanta. Also plans a 50 x 100 ft. plant at Fiske and Dalton Sts., Spokane, Wash. $40,000.

Pottery Plant—Cowan Pottery Studio, R. G. Cowan, Pres. 19633 Lake Rd., Cleveland, O., awarded contract for a 1 story addition to pottery plant to J. C. F. Shafer Co., Smythe Bldg., Cleveland. Estimated cost $49,000.

Potery Plant—Trenton Potteries Co., North Clinton and Ott Sts., Trenton, N. J., awarded contract for addition to building No. 6, 5 story, 65 x 168 ft. on Dewey St. to Karno Smith Co., Inc., Broad St., Bank Bldg., Trenton. Estimated cost $150,000.

Pottery Plant—Weller Pottery Co., Zanesville, O., awarded contract for the construction of a 1 story, 40 x 100 ft. pottery plant at Mentor Ave. on Route 40 to C. O. Vinsel & Son, Zanesville. Estimated cost $40,000.

Rayon Factory—Industrial Rayon Co., H. S. Rivetz, West 98th St. and Walford Ave., Cleveland, O., awarded contract for addition to factory for the manufacture of artificial silk to G. A. Rutherford Co., 2725 Prospect Ave., Cleveland. Estimated cost $75,000.

Rayon Factory—Viscose Co., Marcus Hook, Pa., awarded contract for the construction of a 1 story, 225 x 330 ft. factory at Lewistown to Wark Co., 1608 Walnut St., Philadelphia.

Copper Refinery—Canadian Copper Refinery Inc., subsidiary of Nichols Copper Co., 25 Broad St., New York, N. Y., will receive bids late in spring on construction of and equipment for copper refinery at Montreal, Que. Estimated cost $2,000,000. Private plans. Address Purchasing Agent, Nichols Copper Co., Laurel Hill, L. I., N. Y.

Oil Cracking Plant—White Star Refining Co., Trenton, Mich., awarded contract for the design and construction of addition to cracking plant at oil refinery including piping, tanks and buildings to house equipment to Arthur G. McKee Co., 2424 Euclid Ave., Cleveland, O. Estimated cost $500,000.

Refinery Buildings—McKean County Refining Co., W. H. Rockman, in charge, Farmers Valley, Pa., awarded contract for the construction of a group of buildings including 2 story, 50 x 120 ft. barrel house, 1 story, 65 x 72 ft. wax house, new boiler house, 400 hp., coal handling building, 300 ton capacity, twelve filters, burner building, 16 ft. burners, 2 story, 50 x 200 ft. shop building and 24 x 38 ft. office to L. O. Boquin Co., 11 East First St., Oil City.

Refinery (Oil)—Canadian Oil Co., C. A. Hale, Mgr., Petrolia, Ont., plans the construction of an oil refinery. Estimated cost $500,000. Equipment for the manufacture of high test gasoline will be required.

Refinery (Oil)—Cromwell Oil Co., Big Spring, Tex., plans extensions and improvements to crude oil refinery to double present capacity of 10,000 bbls. daily. Estimated cost $250,000. Private plans.

Refinery (Oil)—Cromwell Franklin Oil Co., Franklin Bldg., Oklahoma City, Okla., is having preliminary plans prepared for the construction of a plant to manufacture greases and oils. Estimated cost $1,000,000. Private plans.

Refinery (Oil) — Seaboard Oil Refining Co. Ltd., 510 West Hastings St., Vancouver, B. C., awarded contract for first unit of oil refinery: bulkheading and fill required for wharf, clearing site and preparations of foundations for numerous steel tanks and refinery buildings proper to Ellis Cotton Co. Ltd., False Creek, Vancouver. Estimated cost $2,000,000.

Refinery (Oil) etc. — Southern Cotton Co., K. C. Junction, Memphis, Tenn., awarded contract for the construction of a 4 story, 87 x 100 ft. oil refinery, 2 story, 22 x 55 ft. laboratory, 1 story, 40 x 100 ft. acidating building, fifty-five oil tanks, 60,000 to 100,000 lb. capacity to S. & W. Construction Co., Shrine Bldg., Memphis. Estimated cost $250,000.

Refinery (Oil) Additions — Rotary Process Refining Co., 850 Subway Terminal Bldg., Los Angeles, Calif., awarded contract for additions to oil refinery on Perry Rd., Downey to Engineering Research & Equipment Co., 1351 East 17th St., Los Angeles. Estimated cost $60,000.

Salt Refinery—Consumers Salt Co., c/o H. A. Pitts, El Paso, Tex., is having preliminary surveys made for the construction of a salt refinery. Estimated cost $30,000.

Rubber Manufacturing Plant—Castle Rubber Co., N. E. Brown, Secy. and Treas., Etna St., Butler, Pa., manufacturers of mechanical rubber products, awarded contract for the construction of a 1 story, 72 x 325 ft. rubber manufacturing plant and 36 x 40 ft. power house to L. Etzel, Great Belt, Pa.

Soap Plant, Perfume Manufacturing Building and Warehouses—Procter & Gamble Co., 510 North Dearborn St., Chicago, Ill., and 205 East 42nd St., New York, N. Y., awarded contract for a 100 x 500 and 100 x 700 ft. plant including 500 ft. wharf and 14 steel storage tanks, etc. on West 7th St., Long Beach, Calif., to Stone & Webster, Inc., Homer Laughlin Bldg., Los Angeles, Calif., who are receiving bids for 10,000 raw untreated piles and 3,400 creosote piles; also awarded contract for a 1 and 2 story perfume manufacturing plant and two warehouses at Port Ivory (Staten Island) N. Y. to Barney Ahlers Construction Co., 110 West 40th St., New York, and steel tanks and industrial building at Western Ave. and Richmond Terrace, Port Richmond, N. Y. to Hammond Iron Works, 17 Battery Pl., New York. Estimated cost $5,000,000, $150,000 and $40,000 respectively.

Coke Screening Plant—Bethlehem Steel Corp., Bethlehem, Pa., awarded contract for the construction of a coke screening plant to Pittsburgh Coal Washer Co., Fulton Bldg., Pittsburgh. Estimated cost $80,000.

Open Hearth Furnaces — Great Lakes Steel Corp., Tecumseh Rd., Detroit, Mich., has work under way on the construction of a battery of six 150 ton open hearth furnaces for new plant now under construction.

Sheet Mill, Blooming Mill, Furnaces, Coke Ovens, Etc.—Gulf States Steel Co., W. H. Coverdale, Pres., Brown-Marx Bldg., Birmingham, Ala., plans to expend between $17,000,000 and $20,000,000 for new mills and additions to plant at Gadsden, to include blooming mill, $1,000,000; plate mill, $2,000,000; sheet mill, $2,000,000; four open-hearth steel furnaces, 27 by-products coke ovens; 5,000 ton blast furnace; and power plant duplicating $3,500,000 plant completed last year. Work under way on blooming mill and sheet mill.

Smelter Plant—American Smelting & Refining Co., 120 Broadway, New York, N. Y., plans the construction of a smelter plant at Red Indian Lake, N. F. Estimated cost $500,000. Indefinite when project will mature.

Smelting and Refining Mill—St. Louis Smelting & Refining Co., Interstate Life Bldg., St. Louis, Mo., have acquired a 190 acre tract near Waco, Tex., formerly operated by High Five Mining Co. and American Zinc Co. and plans a central mill to handle tonnage from this and other holdings to include full equipment for zinc and ore mining, etc. Private plans.

Sugar Mill Equipment—Compania Azucarera del Mante, Tampaulipas, Mexico, awarded contract for electrical equipment including two 1,500 kw. turbo-generators and auxiliary equipment to cost $175,000 for use in sugar mill, initial capacity 1,250 metric ton of cane daily at Villa Jaures, Tampaulipas. $1,600,000. Plant will be built by Fulton Iron Works Co., 1259 Delaware Ave., St. Louis, Mo.

Tarmac Cold Mix Plant—American Tar Products Co., Koppers Bldg., Pittsburgh, Pa., will build a tarmac cold mix plant, 1000 ton capacity at Utica, N. Y. Work will be done by owners forces.

Vitalic Factory—Vitalite Corp., 415 West 5th St., Santa Ana, Calif., will build a 1 and 2 story 80 x 125 ft. factory. Work will be done by day labor.